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SOME DESCRIBED SPECIES OF PORIA

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The brown and black species of this group have already been treated in *North American Flora* and one genus, *Xanthoporia*, was recently described in *Mycologia*. The resupinate polypores are particularly difficult for several reasons. In the first place, they lack the definite shape which is often a determining character in the pileate forms; they are, moreover, entirely destitute of a "surface," with the various important characters which it usually affords; and they are mostly small, the characters that are present being necessarily on a small scale.

As a rule, each individual specimen has to be examined with the microscope, and, even then, the well-known variability in microscopic characters often leaves one in doubt. In working with original specimens in foreign herbaria, it is often impossible to get satisfactory results because of the character of the work required and the time it consumes. Accidental resupinate forms among pileate species also give considerable trouble because of their close resemblance to forms uniformly resupinate, and for this reason a wide and accurate knowledge of pileate forms is essential.

The white and bright-colored resupinates are more difficult than the rest because there are more species with fewer characters, more confusion with pileate forms, and less chance of obtaining spore characters. Specimens found in the herbaria are almost invariably without notes, as well as without good spores, so that the preparation of adequate descriptions must be

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left to those having access to fresh specimens or to recently collected material.

Herbarium specimens are also badly mixed and it is necessary in nearly all cases to get at the actual types for comparison. Histological studies and enlarged drawings from type material may be interesting and helpful but they can never take the place of the types themselves. What we need is an abundance of carefully collected and described fresh material closely compared with originals and distributed to all the principal taxonomic centers for the use of students in identification. We thought that the pileate polypores were sufficiently confused in American collections, but the resupinates are many times worse.

1. **Poria humilis** nom. nov.

Polyporus incrustans Berk. & Curt.; Berk. Grevillea **1**: 54. 1872. Not *P. incrustans* Pers. Myc. Eur. **2**: 93. 1825.

Poria incrustans Sacc. Syll. Fung. **6**: 330. 1888.

"Mollis, albus; quisquilias incrustans; mycelio gossypino; poris brevibus angulatis; dissepimentis tenuibus. No. 5671. New England. Murray.

"Running over grass and various substances, after the fashion of *Thelephora sebacea;* white, soft, springing from a thin cotton-like mycelium; pores 1/80 inch wide, short, angular, with thin dissepiments."

Described from specimens collected in New England by Murray and still to be seen at Kew. The tubes are rather primordial.

2. **Poria elachista** (Berk.) comb. nov.

Polyporus minimus Rav.; Berk. Grevillea **1**: 65. 1872. Not *P. minimus* Fries. 1838.

Polyporus elachista Berk.; Cooke, Grevillea **15**: 57. 1886.

"Pulvinatus fere totus e poris mollibus ceraceis candidis elongatis minimis constitutus. No. 2988. Car. Inf.

"Only one or two lines across, forming little cushions, consisting almost entirely of very minute, elongated, wax-like pores."

Type from South Carolina by Ravenel. Only four small fragments were to be seen at Kew, and these were of little use. A

specimen so named in the Desmazières collection at Paris proved to be *Coriolellus sepium*.

3. PORIA SALVIAE (Berk. & Curt.) Sacc. Syll. Fung. **6**: 311. 1888

Polyporus Salviae Berk. & Curt.; Berk. Grevillea **1**: 54. 1872.

"Effusus, mollis, albus, fere totus é poris minimis flexuosis constitutus; dissepimentis tenuibus. No. 2602. Car. Inf. On *Salvia*, surrounding the branches, consisting almost entirely of the minute flexuous pores; dissepiments thin; pores $\frac{1}{100}$ inch in diameter. Allied to *P. vaporarius*."

Type from South Carolina by Ravenel on sage. Seen at Kew and also in the Ellis Herbarium. An abnormal, cellular form almost devoid of context.

4. PORIA CANDIDISSIMA (Schw.) Sacc. Syll. Fung. **6**: 310. 1888

Polyporus candidissimus Schw. Trans. Amer. Phil. Soc. **4**: 159. 1832.

"P. effusus; membrana tenuissima, bombycina, sed tamen detrahenda. Poris maximis demum obliquis, cum membrana candidissimis. Ad Polystictas pertinere videtur, sed membrana detractabilis obstat."

Type from Bethlehem, Pennsylvania, by Schweinitz, on decayed wood. At Philadelphia but not at Kew. Thin, white, like a cobweb, with a shallow network of tubes resembling holes in a veil.

5. PORIA CALCEA (Schw.) Sacc. Syll. Fung. **6**: 330. 1888

Polyporus calceus Schw. Trans. Amer. Phil. Soc. **4**: 159. 1834.

Known only from specimens collected on a fallen trunk in Bartram's garden, Philadelphia. Schweinitz thought these specimens the same as *Polyporus vulgaris calceus* Fries, Syst. Myc. **1**: 381. 1821, which variety he considered sufficiently distinct to deserve specific rank. The American plant, however, has no such close connection with the plant known to Fries. *Poria calcea* Berk. & Br. was used later for a Ceylon species.

6. PORIA INTERNA (Schw.) Sacc. Syll. Fung. **6**: 293. 1888

Polyporus internus Schw. Trans. Amer. Phil. Soc. **4**: 159. 1832.

"P. longitudinaliter penetrans in cavitatibus trunci putridi varie flexuosus ad 3–4 uncias, primo mollusculus, crassus margine demum inflexo. Tubis saepe obliquis longioribus. Poris flexuosis minutis. Color totus albus, nisi statu sicco subpallescit."

Type from Bethlehem, Pennsylvania, by Schweinitz, on the interior of trunks. Said to be frequent. Still to be seen at Kew.

7. PORIA XANTHOLOMA (Schw.) Sacc. Syll. Fung. **6**: 324. 1888

Polyporus xantholoma Schw. Trans. Amer. Phil. Soc. **4**: 158. 1832.

"P. effiguratim effusus, tenuissimus, margine membranaceo fimbriato, latiusculo, sterili, eleganter luteo. Poris superficialibus, parietibus crassiusculis, subsinuosis, minutis, pallidis. Plagas 1–2 unciales irregulares efformat, ligni inaequabilitatem forma sequens."

Type from Salem, North Carolina, by Schweinitz, on decayed wood. Several things are referred to this species at Kew, all of which may be different from the type at Philadelphia.

8. PORIA LIMITATA (Berk. & Curt.) Sacc. Syll. Fung. **6**: 324. 1888

Polyporus limitatus Berk. & Curt.; Berk. Grevillea **1**: 54. 1872.

"Totus resupinatus rigidus allidus; margine nigrescente rimoso; poris angulatis. No. 2686. Car. Inf. Entirely resupinate, the margin thin, barren, and cracked. Pores $\frac{1}{70}$ inch wide.

Described from specimens collected on dead trunks in South Carolina. The tubes seem rather primordial and inclined to be rigid. Compare *P. tenuis*.

9. PORIA TENUIS (Schw.) Sacc. Syll. Fung. **6**: 331. 1888

Polyporus tenuis Schw. Trans. Amer. Phil. Soc. **4**: 159. 1832.

"P. longe longitudinaliter effusus, membranam sistens tenuem subdetrahendam albo-pallentem aequabilem margine substerili albidiori. Poris majusculis subflexuosis, parum excavatis pallidis"

Type from Bethlehem, Pennsylvania, by Schweinitz, on the interior fibrous bark of chestnut. Well preserved at Philadelphia. Compare *P. limitata*.

10. PORIA SASSAFRAS (Schw.) Sacc. Syll. Fung. **6**: 294. 1888

Polyporus Sassafras Schw. Trans. Amer. Phil. Soc. **4**: 158. 1832.

"P. substantia molliuscula, bibula; subiculo vix in margine conspicuo; tubis in centro satis elongatis, crassiusculis. Poris minutis, regulariter rotundis. Longitudinaliter in ligno ac cortice effusus (colore pallide lutescente) ad 1–2 uncias."

Type from Bethlehem, Pennsylvania, by Schweinitz, on much decayed sassafras wood. Seen at Philadelphia. Said to be frequent.

11. PORIA ALABAMAE (Berk. & Cooke) Sacc. Syll. Fung. **6**: 323. 1888

Polyporus Alabamae Berk. & Cooke; Berk. & Curt. Grevillea **6**: 130. 1878.

"Effusus, determinatus, lobatus, albus, exsiccate ochraceus, marginque albo floccoso; poris minoribus, subrotundis.

"The distinct, barren, floccose margin is broad when young, but diminishes with age; it is nevertheless always distinguishable as a paler marginal zone."

Described from specimens collected at Gainesville, Florida, by Ravenel on branches of *Myrica cerifera*. See Rav. Fungi Am. Exsic. *110*. Well preserved at Kew. Collected in abundance in Florida by Calkins and also in Mississippi by Tracy. The spores have been described as elongate-ellipsoid, smooth, thin-walled, hyaline, $11 \times 4.5\ \mu$.

12. PORIA CINCINNATI Berk.; Cooke, Grevillea **15**: 27. 1886

"Effusa, ochraceo-pallida, tenuis, subtomentosa, margine extremo elevato, poris magnis, concavis, inaequalibus, rotundato-angulatis, dissepimentis brevibus, obtusis, hinc illic suppressis."

Type from Cincinnati, Ohio, by Lea, on bark. Characterized by large and unusually shallow tubes. Specimens at Kew were at first called *P. tenuis* Schw., which is quite a different plant.

13. PORIA PULCHELLA (Schw.) Sacc. Syll.
Fung. **6**: 323. 1888

Polyporus pulchellus Schw. Trans. Amer. Phil. Soc. **4**: 158. 1832

"Rarior Bethlehem, olim *xanthus* mihi; cortice increscit.

"P. resupinato-effusus, superficie inaequali, subplicata, rugosa, ambitu determinatus; margine undulato tumido, substerili. Poris minutis, regularibus, angustatis, tubus subobliquis in rugis superficiei.

"Totus fungus flavescens, durus, siccus, uncialis."

Type from Bethlehem, Pennsylvania, by Schweinitz, on bark. Well preserved at Philadelphia and Kew. According to Bresadola, this is only a variety of *Poria medullapanis,* but I can hardly concur in his opinion. Specimens so named in Peters' collection from Alabama have much thicker dissepiments.

14. PORIA CARYAE (Schw.) Sacc. Syll.
Fung. **6**: 306. 1888

Polyporus Caryae Schw. Trans. Amer. Phil. Soc. **4**: 159. 1832.

"P. junior tuberculoso-elevatus, interruptus, substantia spongiosa-tomentosa, margine sterili saepe tumido. Demum late effusus, magis aequabilis et subindurescens, margine tunc tenuissimo, submembranaceo, candido, praeditus. Tubis brevibus, parietibus crassiusculis, poris minoribus subrotundis et subflexuosis; interdum regulariter effusis, interdum pulvinatim in tuberculos elevatis. Ex fuliginis cinerascit. Ad pedalem longitudinem sub trunco effusus."

Described from specimens collected by Schweinitz at Nazareth, Pennsylvania, on a fallen hickory log. Types are well preserved at Philadelphia and Kew.

15. PORIA BEAUMONTII Berk. & Curt.; Cooke,
Grevillea **15**: 26. 1886

"Effusa, adnata, crassiuscula, ochraceo-pallida, margine angusto subtomentoso, poris majusculis, subaequalibus, rotundo-angulatis, dissepimentis acie acutis, integris."

Type from Alabama, by Beaumont, on wood. The type sheet at Kew contains two collections from Alabama by Beaumont. Our No. *429* is *Coriolopsis rigida,* different from that sent to Kew. Compare *P. omoema.*

16. PORIA OMOEMA Berk.; Cooke, Grevillea **15**: 26. 1886

"Effusa, ochraceo-alba, rigida, e mycelio tomentosa albida constipata, subtus villosa; poris mediis (⅖–⅓ mm.), angulatis, integris, plerumque obliquis.—*Polyporus omoemus,* Berk. in Herb. No. 2837, *P. radula,* Rav. Amer. Exs. No. 107."

Type from South Carolina, by Ravenel, on trunks of pine. In good shape at Kew. Compare *P. Beaumontii.*

17. PORIA TOMENTO-CINCTA Berk. & Rav.; Cooke, Grevillea **15**: 26. 1886

"Effusa, adnata, subrigida, ochraceo-pallida, margine subtomentoso, poris majusculis, rotundatis, aequalibus, dissepimentis crassiusculis, acutis."

Type from Aiken, South Carolina, by Ravenel, on oak bark. See Rav. *1771.* Also from Darien, Georgia, by Ravenel, on oak (see Rav. Fungi Am. Exsic. *215*), Colorado, by Bethel, on dead wood, and New Jersey, by Ellis, on maple bark. Compare *P. holoxantha* and *P. dryina.*

18. PORIA HOLOXANTHA Berk. & Cooke; Cooke, Grevillea **15**: 26. 1886

"Orbicularis, dein confluens effusaque, ochraceo-pallida, adnata, subrigida, poris majusculis, subaequalibus, rotundatis, dissepimentis tenuibus, margine acutis.—*Polyporus holoxanthus,* Berk. and Cooke in Rav. Amer. Fungi No. 213–214, Herb. Berk. No. 2848.

"Pores smaller than in *P. omoema.* Some of these American species are doubtfully distinct."

Type from Darien, Georgia, by Ravenel, on oak. See Rav. Fungi Am. Exsic. *214.* Specimens from the same locality on *Myrica* were considered a variety when the exsiccati were issued (see Rav. Fungi Am. Exsic. *213*), but there is no reference to this distinction in the published description. Compare carefully with *P. tomento-cincta* and *P. dryina.*

19. PORIA DRYINA (Berk. & Cooke) Sacc. Syll. Fung. **6**: 315. 1888

Polyporus dryinus Berk. & Cooke; Berk. & Curt., Grevillea **6**: 130. 1878.

"Effusus, innatus, albidus, demum ochraceus; mycelio floccoso, albo; poris quandoque subrotundis, quandoque angulatis et inaequalibus, in stratum persistens constipatis; dissepimentis tenuibus."

Type from Aiken, South Carolina, by Ravenel, on oak branches. See Rav. Fungi Am. Exsic. *111*. Also seen at Kew, where it is somewhat mixed. Berkeley's remark about its "resembling *P. vaporarius* in some conditions" is entirely misleading. Compare *P. tomento-cincta* and *P. holoxantha*.

20. PORIA FATISCENS (Berk. & Rav.) Sacc. Syll. Fung. **6**: 331. 1888

Polyporus fatiscens Berk. & Rav.; Berk., Grevillea **1**: 65. 1872.

"Totus resupinatus albus tenuissimus pulveraceus; poris serius enatis primum punctiformibus dein angulatis. Car. Inf. Entirely resupinate. At first consisting of a thin white pulverulent stratum, which, after a time, bears pores about $\frac{1}{100}$ inch wide, which are at first punctiform, then angular."

Type from South Carolina, by Ravenel, on dead branches. See Rav. Fungi Car. Exsic. **2**: *21*. Although no mention is made of it in the description, herbarium specimens show the margin and very young tubes to be white and unchanging, while the older tubes exhibit various shades of yellow from sulphur-yellow to chrome-yellow. It would be interesting to know if this is true of fresh specimens.

21. PORIA FUSCO-MARGINATA Berk.; Cooke, Grevillea **15**: 24. 1886

"Orbicularis, elliptica vel confluens, adnata, ochraceo-pallida, margine tenui, membranaceo, sterili, fusco, poris minutis, rotundatis, aequalibus, centro tubulis elongatis, peripherico curtissimis, dein obsoletis, dissepimentis tenuibus."

Type from Rhode Island, on wood. Poorly preserved and scrappy at Kew, suggesting little.

22. PORIA RICHERIAE Pat. Bull. Soc. Myc. France **15**: 200. 1899

"Résupiné, inséparable du support, largement étalé, plan ou onduleux, dur et compact, crevassé par le sec, ayant à peine 1

millim. d'épaisseur, crême avec un reflet grisâtre ou violacé, entouré d'une marge stérile, très mince, lisse et d'un blanc de craie. Pores extrêmement petits (environ 60 μ de diamètre), superficiels, anguleux-sinueux, profunds de 40 à 50 μ. Trame blanchâtre, traversée dans toute son épaisseur par les cloisons qui sont très minces (30 à 50 μ) et entières."

Type from Guadeloupe, by Duss, on a trunk of *Richeria grandis*. Although I have visited Dr. Patouillard's private herbarium at Neuilly several times, I have no record of having examined this species.

23. PORIA DECOLORANS (Schw.) Sacc. Syll. Fung. **6**: 321. 1888

Polyporus decolorans Schw. Trans. Amer. Phil. Soc. **4**: 159. 1832.

"P. minutus, 3–4 lin. diametro, sed longe lateque confluens, non effusus, sed quasi totaliter affixus, margine inflexo libero, membranaceo. Primum mollusculus, albus, decolorans ac sordide brunneus devenit. Poris magnis subflexuosis, e forma orbiculari in flexuosam confluit. Tenerrimus."

Type from Bethlehem, Pennsylvania, by Schweinitz, on fallen bark. Seen at Philadelphia but not at Kew.

24. PORIA CLATHRATA (Berk. & Curt.) Sacc. Syll. Fung. **6**: 312. 1888

Polyporus clathratus Berk. & Curt.; Berk. Grevillea **1**: 54. 1872.

"Niveus, effusus, late cribrosus; parietibus cribrorum laccato-laevibus; poris punctiformibus, dissepimentis crassis obtusis. No. 3656. Louisiana. Dr. Hale. Widely effused, the hymenium with large apertures, the walls of which are smooth and honey colored. Pores $\frac{1}{72}$ inch wide."

Type from Louisiana, by Dr. Hale, on trunks. Poorly preserved at Kew and seems abnormal, or at least peculiar. The "large apertures" are difficult to explain.

25. PORIA CREMOR (Berk. & Curt.) Sacc. Syll. Fung. **6**: 297. 1888

Polyporus cremor Berk. & Curt. Hook. Jour. Bot. **1**: 104. 1849.

"Resupinatus, albus; margine obsoleto poris paris subrotundis, dissepimentis crassis, acie obtusissima.

"Resupinate, white, about an inch broad, consisting almost entirely of tubes. Margin obsolete. Pores small, round or slightly sinuated, their edge very obtuse.

"A distinct but not very remarkable species, allied most to *P. vulgaris,* but differing in its thick dissepiments and the obtuse edge of the pores."

Type from South Carolina, by Ravenel, on decayed oak branches and frequently on the disks whence twigs had been broken off. Seen at Kew and Upsala. The description was worked over for Grevillea **1**: 54. 1872, but too much stress was placed in both descriptions on the obtuseness of the dissepiments. It is quite distinct from *Poria drying.*

26. PORIA RIVULOSA (Berk. & Curt.) Sacc. Syll. Fung. **6**: 293. 1888

Polyporus rivulosus Berk. & Curt. Jour. Linn. Soc. **10**: 318. 1868.

"Candidus, effusus, carnosus (siccus contractus rimulosus), margine tenui tomentoso; poris mediis rotundis, dissepimentis crassis pruinosis.

"On dead *Polypori.* Margin at length more or less free. Pores 1/60 inch in diameter."

Type from Cuba, by Wright, on dead polypores. Parts of the original may be seen at Kew and Paris.

27. PORIA ANAECTOPORA (Berk. & Curt.) Sacc. Syll. Fung. **6**: 326. 1888

Polyporus anaectoporus Berk. & Curt. Jour. Linn. Soc. **10**: 318. 1868.

"Totus resupinatus, margine tenuissimo; poris magnis hiantibus saepe decurrentibus (siccis rufis), dissepimentis rigidis subacutis.

"On dead bark. Pores 1/12–1/18 inch in diameter; their fructifying surface waxy."

Known only from specimens collected by Wright on dead bark in Cuba. Very peculiar, with large shallow tubes like those of *Favolus,* which become reddish when dry.

28. PORIA BARBAEFORMIS (Berk. & Curt.) Sacc. Syll. Fung. **6**: 316. 1888

Polyporus barbaeformis Berk. & Curt.; Berk. Grevillea **1**: 53. 1872.

"Totus resupinatus; margine tenui, albo; hymenio fulvo; poris parvis, elongatis, dissepimentis tenuibus. No. 4519. Alabama. Peters. On vine.

"Wholly resupinate with a thin white margin; hymenium tawny; pores 1/48 inch wide, but variable in size."

Type from Alabama, by Peters, on vine. Only small scraps of the original collection are to be seen at Kew. Specimens there from Pennsylvania and elsewhere do not agree with the type. Several fine specimens, true to type, were collected by Underwood on *Vitis* at Auburn, Alabama, in December, 1895, and January, 1896. These are now in the herbarium of the New York Botanical Garden. The tubes are milk-white on the edges and ochraceous-isabelline within.

29. PORIA VESICULOSA (Berk. & Curt.) Sacc. Syll. Fung. **6**: 332. 1888

Polyporus vesiculosus Berk. & Curt.; Berk. Grevillea **1**: 65. 1872.

Polyporus tenellus Berk. & Cooke; Cooke & Ellis, Grevillea **6**: 81. 1878.

Poria tenella Sacc. Syll. Fung. **6**: 331. 1888.

"Late effusus alutaceus; poris pezizaeformibus veluti è vesiculis ruptis enatis.

"Widely spreading, pale tan-colored; pores 1/100 inch wide, looking like minute burst bladders."

Described from specimens collected by Peters on pine planks in Alabama. Peck considered it in 1885 a variety of his quite variable *P. subacidus*. *Polyporus tenellus*, described from specimens collected by Ellis on pine boards at Newfield, New Jersey, doubtless represents only a younger stage of *P. vesiculosus* than that secured by Peters. It was originally described as follows:

"Totus resupinatus, albus, demum ochraceus, tenuissimus, pulveraceus; margine byssino, albo; poris angulatis, inaequalibus, brevibus, ad centro confertis.

"Allied to *P. fatiscens*, B. & R., very thin, with a broad white sterile byssoid margin."

30. **Poria subsulphurea** (Ellis & Ev.) comb. nov.

Myriadoporus subsulphureus Ellis & Ev. Bull. Torrey Club **24**: 277. 1897.

"Effused, immarginate, wood-color or grayish-white outside, light sulphur-yellow within, of a brittle corky texture, stratose, 4–5 mm. thick, extending continuously from 5–6 cm. or more; pores imperfectly developed, not continuous and cylindrical, but mere cavities scattered irregularly through the substance, more abundant near the surface.

"Has the general appearance of *Poria vulgaris* Fr. or *P. obducens* Pers."

Type from Denver, Colorado, by E. Bethel on dead coniferous wood. It is very pale yellow and the tubes are cellular and stratose. Abnormal forms like this species, *Poria indurata,* and *Poria vesiculosa,* etc., will have to be retained under their present names until more fully investigated. They may be only monstrous forms of well-known species or they may be distinct.

31. PORIA FAVESCENS (Schw.) Sacc. Syll. Fung. **6**: 325. 1888

Polyporus favescens Schw. Trans. Amer. Phil. Soc. **4**: 158. 1832.

"Non absimilis *P. megaloporo,* Pers. Myc. Eur. 105, differt colore. Bethlehem rarius in ramis. Favum refert.

"P. resupinato-effusus ad pedalem longitudinem, crassus, margine tenui subalbido, determinatim elevato ambitu. Poris latiusculis, hexagonis; tubis longissimis, pallidis."

Type from Bethlehem, Pennsylvania, by Schweinitz, on dead branches. To be seen both at Kew and Philadelphia. Compare carefully with *Poria Rhododendri* and *Coriolellus sepium,* from which it can hardly be distinct.

32. PORIA RHODODENDRI (Schw.) Sacc. Syll. Fung. **6**: 322. 1888

Polyporus Rhododendri Schw. Trans. Amer. Phil. Soc. **4**: 158. 1832.

"P. longitudinaliter effusus, angustatus. Primum observatur membrana papyracea, detractabilis, albescens aut pallescens, in cujus centro *pori* pauci parum elevati, lati, occurrunt. Demum

poris his, tota superficie obsita est, membrana, tantum non in ambitu ubi sublibera et subinflexa. Poris tandem in tubos angulatos, margine fimbriatos, 2–3 lineas altos, ex pallide fuscescentes, elevatis. Totus fungus 1–3 uncias longus, ¼ unc. latus, affinis *P. contiguo.*"

Type from Bethlehem, Pennsylvania, by Schweinitz, on fallen trunks of *Rhododendron maximum.* Compare carefully with *Poria favescens* and *Coriolellus sepium.*

33. PORIA HYPERBOREA Berk.; Cooke, Grevillea **15**: 27. 1886

"This also is a very doubtful species, not apparently described. There is but a single specimen, which apparently is the resupinate condition of *Polystictus,* and probably *P. hirsutus* or *P. velutinus.*"

Type from British North America, by Dr. Richardson, on trunks. Cooke was perfectly correct in saying that this is merely a resupinate condition of some species of *Coriolus.* Berkeley left a number of manuscript species in the herbarium at Kew, many of them worthless, which were no doubt held back purposely. One should be extremely careful about publishing herbarium names unless he can secure permission from the author; for in striving to give credit, he may bring discredit.

34. PORIA FAVILLACEA (Berk. & Curt.) Sacc. Syll. Fung. **6**: 305. 1888

Polyporus favillaceus Berk. & Curt.; Berk. Grevillea **1**: 53. 1872.

"Brevis, sparsus; margine liberato, tomentoso; hymenio cinereo; poris minimis. No. 5266. New Eng., Sprague. Consisting of little scattered patches; margin at length free and tomentose; hymenium ash-colored; pores $\frac{1}{150}$ inch wide. Parasitic, together with a minute Hydnum, on some indeterminable resupinate Polyporus."

Type from New England, by Sprague, on trunks. Seen at Kew. The little patches somewhat resemble *Aleurodiscus Oakesii,* while the tubes are much smaller than those of *Coriolus abietinus.*

35. PORIA LINDBLADII (Berk.) Sacc. Syll. Fung. **6**: 306. 1888

Polyporus Lindbladii Berk. Grevillea **1**: 54. 1872.

"Pileo resupinato, rigido; margine tomentoso albo demum libero; hymenio griseo, fuscescente; poris angulatis. No. 1623. Car. Inf. Spreading for some inches; of a peculiar grey tint. Pores 1/60 inch wide. The Carolina specimens are a little darker than those originally received from Sweden."

Described from specimens collected in South Carolina, by Ravenel, on trunks. Seen at Kew, Paris, and Upsala. It is only a resupinate form of *Polyporus floridanus* Berk., which is a small-pored variety of *Coriolus sector*.

NEW YORK BOTANICAL GARDEN.

SOME COLORADO FUNGI*

L. O. Overholts

Except for a considerable number of papers on parasitic fungi, very little literature dealing with the fungous flora of the western states has yet appeared. As a matter of fact a prodigious amount of work is necessary before the fungi of any large section of the United States can be accurately catalogued. As a means to this end carefully prepared check lists are invaluable, provided the specimens and notes on which they are based are adequately preserved. Such lists are also of some value to local collectors, both in aiding them in their determinations and in stimulating more widespread interest in collecting and preserving the specimens.

The writer spent parts of the summers of 1913 and 1914 at the Mountain Laboratory of the University of Colorado for the purpose of collecting the fleshy and woody fungi of that region. Through the efforts of Dr. Francis Ramaley, Professor of Botany in the University of Colorado, a certain amount of financial assistance was obtained from that institution in return for a duplicate set of the specimens collected. These are, therefore, deposited in the herbarium of that University. The most complete set of specimens is retained in the writer's herbarium. Duplicates of some of the collections are in the herbarium of the Missouri Botanical Garden and the New York Botanical Garden.

The Mountain Laboratory of the University of Colorado is located in the town of Tolland, in Gilpin County, Colorado. This town lies on the Moffatt Railroad 47 miles northwest of Denver, and on South Boulder Creek. South Boulder Park, in which the town lies, has become well known to botanists through the writings of Dr. Ramaley, Professor W. W. Robbins, and others interested in the ecology of the eastern slopes of the Rocky Mountains. It lies at an elevation of practically 9,000 feet

* Contribution from the Department of Botany, The Pennsylvania State College, No. 18.

above sea level. The park itself is a dry grass land area about 2 miles long and half a mile wide, through which flows South Boulder Creek. Dense willow growths border parts of this stream and the soil beneath supports in proper season a considerable fungous flora. The grass land is too dry for all except those fungi of decided xerophytic habits, among the most important of which are puffballs, the fairy ring *Tricholoma* (*T. praemagna*), and *Agaricus campestris*. The best collecting is to be found in the coniferous forests bordering the various streams that enter the park from the surrounding gulches and cañons. Of these the best in this locality are South Boulder Cañon and Jennie Creek. The latter is not much above the level of the park floor in elevation, but the former is a deep though fairly broad cañon extending from the west end of the park up to the continental divide, a distance of about 4 miles and with an elevation of from 9,000 to more than 10,000 feet. The tree growth in this cañon (as well as bordering all other streams) is largely of coniferous species, mostly *Picea engelmannii*. On the drier mountain slopes the lodge-pole pine predominates, and aspen thickets are not infrequent in moist situations.

Owing to the high elevation of this region spring is late in arriving and in both 1913 and 1914 snow drifts remained in the surrounding forests until nearly July 1, and at higher elevations much later. Both seasons the rainfall was light until about the middle or latter half of July, although light showers are of frequent (sometimes almost daily) occurrence. In July, however, heavy rains occurred and it was following these that fungi were found in greatest abundance. Apparently the fungous flora is not an unusually rich one, partially because of the short growing season. A total of nearly 1,000 collections were made in the two seasons but in neither instance did the collecting cover the entire season.

A considerable amount of information was collected as to the altitudinal distribution, seasonal appearance, and other ecological data pertaining to the fleshy fungi, but its publication is withheld for the present with the hope of adding to it in the near future. However, there appears to be almost as decided a suc-

cession of fungous genera and species throughout the season as is the case in flowering plants. The fact that with the rapid disappearance of the snow in June the earth warms up more rapidly than in places at lower elevations, makes this type of locality unusually favorable for studying this succession of forms.

In 1914 two days were spent in collecting in the vicinity of Denver and Golden in company with Professor E. Bethel, and those collections are included in this report. Professor Bethel has also sent in at various times specimens collected in different localities. Dr. Ramaley has supplied a small collection of specimens from Boulder and Tolland. But by far the larger part of the numbers here reported are from the vicinity of Tolland and collected by the writer.

Unfortunately the literature on American gill fungi is yet so fragmentary that it has been impossible to identify a large percentage of the collections in that family. Undoubtedly a considerable number of these are new to science but none such are described at this time.

The entire number of species listed in this report is 152. If all the collections obtained were determined the list would be at least twice as large. Even that number would represent only a fraction of the entire number of species to be found in this locality if the collecting could be extended over several entire seasons.

The writer desires to acknowledge his obligations to the University of Colorado and especially to Dr. Ramaley for furthering this work in all possible ways, and to other members of the laboratory staff and the various students whose interest in the work was decidedly helpful. In certain groups of these fungi the determinations have been made by specialists and such determinations have added considerably to the completeness and the accuracy of this list. Due credit is given throughout the list for determinations so made.

ASCOMYCETES[1]

[1] All determinations of Ascomycetes were either made or verified by Dr. F. J. Seaver.

1. ORDER SPHAERIALES

1. *Diatrypella verruciformis* (Ehrh.) Nito. On Alnus. Golden. Alt. 7000 ft. June 14, 1914. No. 1767.

2. ORDER PEZIZALES

2. *Discina ancilis* (Pers.) Sacc. On wet ground in coniferous forests. Jennie Creek and South Boulder Cañon. Alt. 9,000–10,500 ft. June 16, 19, 21, 30, 1914. Nos. 1739, 1805, 1810, 1841. Also collected by Dr. Ramaley at Tolland in 1912.

Mature specimens bear considerable resemblance to *Gyromitra*. It is one of the earliest forms to appear in the springtime, following immediately after the disappearing snowdrifts.

3. *Geopyxis cupularis* (L.) Sacc. On ground where fires have been kindled. South Boulder Cañon. Alt. 9,000 ft. June 19, July 8, 22, 1914. Nos. 1796, 1879, 1968.

A beautiful species, yellowish or brownish, more or less urn-shaped and about 1 cm. high.

4. *Pseudoplectania fulgens* (Pers.) Fuckel. On ground in coniferous forests. South Boulder Cañon. June 30, 1914. No. 1839.

5. *Sepultaria arenicola* (Lév.) Boud. On ground in aspen thicket. South Boulder Cañon. July 29, 1913. No. 2035.

6. *Cenangium populneum* (Pers.) Rehm. On dead limbs of *Populus*. Golden. Alt. 7,000 ft. June 14, 1914. No. 1755. The collection was made in company with E. Bethel.

3. ORDER HELVELLALES

7. *Gyromitra esculenta* (Pers.) Fr. On ground in coniferous forests. Ladora. Alt. 9,000 ft. June 21, 1914. No. 1806.

8. *Gyromitra gigas* (*Krombh.*) *Cooke*. On ground in coniferous forests. South Boulder Cañon. Alt. 10,000 ft. June 25, 30, 1914. Nos. 1829, 1837.

9. *Helvella infula* Schaeff. On ground in coniferous forest. Tolland, June 20, 1914. No. 1804.

10. *Helvella lacunosa* Afzel.? On ground in marshy aspen thicket. Tolland. July 14, 1913. No. 2008.

11. *Morchella conica* Pers. On ground. Tolland. July 24, 1913. No. 2028. Also collected by Dr. Ramaley in Jenny Lind Gulch, July, 1912.

BASIDIOMYCETES

HEMI-BASIDIOMYCETES

1. ORDER UREDINALES[2]

12. *Gymnosporangium clavariaeforme* (Jacq.) DC. On stems of *Juniperus sibirica*. Tolland. June 16, 1914. No. 1740. Very common on this host.

13. *Melampsora arctica* Rostr. On leaves of *Salix* sp. Tolland. July 16. No. 2563.

14. *Melampsora pyrolae* (DC.) Arthur. On leaves of *Pyrola*. Tolland and Golden. July 1, 1913; June 14, 1914. No. 1746, 2405.

[2] Dr. J. C. Arthur has determined all the rusts with the exception of Nos. 12 and 15, the former of which was determined by Dr. F. D. Kern, and the latter by Prof. C. R. Orton.

15. *Peridermium harknessii* American authors. (Not *P. harknesii* Moore.) Forming galls on *Pinus contorta*. Lake Eldora and Tolland. June 27, 1913, collected by W. W. Robbins. June, 1914, collected by E. Bethel. Nos. 2309, 2831.

The alternate hosts of this rust are species of *Castilleja* and *Orthocarpus*.

16. *Phragmidium montivagum* Arth. On leaves of wild rose. Golden. June 14, 1914. No. 1749.
17. *Puccinia agropyri* Ellis & Ev. On leaves of *Thalictrum*. Tolland. July 19, 1913. No. 3565.
18. *Puccinia fergussoni* B. & R. On leaves of *Viola*. Tolland. July 14. 1913. No. 2010.
19. *Puccinia taraxaci* Plowr. On leaves of *Taraxacum officinale*. June 22, 1914. No. 2564.

EU-BASIDIOMYCETES

1. FAMILY AURICULARIACEAE

20. *Auricularia auricula-judae* L. On pine logs. Tolland. July 16, 1913. No. 2014. Common after the July rains. Edible and quite delicious.

2. FAMILY TREMELLACEAE

21. *Exidia glandulosa* (Bull.) Fr. On dead alder and willow. Golden and Tolland. Alt. 7,000–9,000 ft. July 16, 1913; June 14, 1914. Nos. 1757, 2017.

3. FAMILY DACRYOMYCETACEAE

22. *Guepinia monticola* Tracy & Earle. This species was determined by C. G. Lloyd, but the collection has recently been mislaid and the data concerning it is therefore not available. It was collected at Tolland, on fallen coniferous wood, and has more the appearance of a Discomycete than a Basidiomycete. No. 1737.

4. FAMILY THELEPHORACEAE

23. *Corticium corruge* Burt. On dead pine limbs. Tolland and Glacier Lake (Prof. Bethel). Alt. 9,000–10,000 ft. June 16, 20, 1914. Common on pine slash on the ground. Nos. 1741, 1801, 1803, 2386.
24. *Corticium galactinum* (Fr.) Burt. On old coniferous log. Golden. Alt. 7,000 ft. June 14, 1914. No. 1745.
25. *Peniophora cinerea* Fr. On dead *Alnus*. Golden. June 14, 1914. Nos. 1744, 1769.
26. *Stereum* ————. On coniferous logs. Tolland. June 29, 1913; June 17, 1914. Nos. 1781, 2336. A species quite similar to *Stereum bicolor*, but distinct.
27. *Stereum fasciatum* Schw. On dead *Alnus*. Golden. June 14, 1914. No. 1758.
28. *Stereum rameale* Schw. On dead *Alnus*. Tolland. June 30, 1913. No. 2000. Both this and the preceding species are rare in this locality as contrasted with their abundant occurrence in most eastern states.

29. *Stereum rufum* Fr. On dead limbs of *Populus*. Golden and Tolland. Alt. 7,000–9,000 ft. June 14, July 5, 1914. No. 1761. For an account of this species see von Schrenk, H., Bul. Torr. Club **21**: 385–388. 1894.

30. *Thelephora caryophyllea* (Schaeff.) Fr. On ground in forests and on mountain slopes. Tolland. June 25, 1913; Aug. 3, 1914. Nos. 2208, 2082.

31. *Thelephora palmata* (Scop.) Fr. On Ground in forests. Boulder. June 21, 1914. No. 2385. Collected by E. Bethel. This species is usually easily recognized by the foetid odor of fresh specimens. The odor of this collection still persists after nearly five years in the herbarium.

5. FAMILY CLAVARIACEAE

32. *Clavaria inaequalis* Lasch. On ground among pine needles. Tolland. July 25, 1914. No. 1979.

Common after the July rains. Gregarious and easily obtained in abundance.

6. FAMILY HYDNACEAE

33. *Hydnum imbricatum* (Pers.) Fr. On stream bank in coniferous forest. Tolland. July 28, 1913. No. 2029.

7. FAMILY AGARICACEAE

34. *Agaricus campestris* (L.) Fr. On the ground in dry grassland. Tolland. Alt. 9,000 ft. June 4, 1914. No. 2112. Not abundant but fairly common after the July rains.

35. *Agaricus silvicola* (Vitt.) Fr. On the ground in woods or along their borders. Tolland. Alt. 9,000 ft. June 20, 22, 23, 1914. Nos. 1952, 1966, 2423.

36. *Agaricus villaticus* Brond. On manure heap. Tolland (Golden Sun Mine). Alt. 8,700 ft. June 22, 1914. No. 1811.

This collection is so referred on the basis of the striking resemblance to Cooke's illustrations, pl. 584. It may be only an overgrown form of *A. campestris*. The pileus of the largest specimen was 18 cm. broad, somewhat scaly, avellaneous or wood brown, taste amygdaline.

37. *Amanita muscaria* (L.) Fr. On ground in woods along stream. Tolland. Alt. 9,000 ft. July 27, 1914. No. 1985. But one specimen of this species was collected.

38. *Amanita phalloides* Fr. On the ground in pine woods. Tolland. Alt. 9,000 ft. July 5, 1914. No. 2113. The specimens are not typical and may have to be referred to another species.

39. *Amanitopsis vaginata* (Bull.) Roze. On the ground, especially in aspen thickets. Boulder. July 15, 1914. E. Bethel. Tolland. Alt. 9,000 ft. June 23, July 12, 19, 21, 22, 25, August 3. Nos. 1342, 1929, 1971, 1974, 1975, 2090, 2845, 2852, 2850. Also collected by Dr. Ramaley at Boulder, July 16, 1913.

40. *Anellaria separata* (L.) P. Karst. On manure heaps. Rollinsville. Alt. 8,700 ft. June 22. Tolland, Alt. 9,000 ft. June 23, 25, 1913. Nos. 1242, 1246, 1813.

41. *Bolbitius fragilis* Fr. On the ground among grass. Mammoth Creek. Alt. 9,500 ft. July 18, 1914. No. 1928.

42. *Cantharellus cibarius* Fr. On the ground under lodge-pole pines. Tolland. Alt. 9,000 ft. July 29, 1914. No. 2060.

43. *Cantharellus muscigenus* (Bull.) Fr. On the ground among mosses under conifers. Tolland. Alt. 9,000 ft. June 26, 1913. No. 1263.

An interesting plant, consisting of a short lateral stem, a pileus less than 1 cm. broad, and bearing branched ribs on the lower side.

44. *Clitocybe coloradensis* Murrill. On moist grassy ground under willows. Tolland. July 22, 1913; July 11, 21, 1914. Nos. 1354, 1890, 1953.

No. 1890 is designated as the type of this species by Murrill.

45. *Clitocybe infundibuliformis* (Schaeff.) Fr. On the ground in grassland. Tolland. Alt. 9,000 ft. July 14, 1914. No. 1914.

The small size, infundifuliform pileus, and pinkish-cinnamon color are the chief characteristics.

46. *Clitocybe inversa* (Scop.) Fr. On compost and forest litter. South Boulder Cañon. Alt. 9,000 ft. July 21, 1913; July 8, 22, August 5, 1914. Nos. 1333, 1884, 1961, 2122.

The pileus is pinkish-cinnamon or apricot buff in color, and 5–10 cm. broad. The spores are subglobose, slightly echinulate, 3.5–5 μ. I am indebted to Dr. Murrill for the determination.

47. *Clitocybe laccata* (Scop.) Fr. On the ground, usually along streams. Tolland. Alt. 9,600 ft. June 26, 1913; July 5, 7, 12, 17, 20, 30. Nos. 1258, 1405, 1858, 1870, 1894, 1921, 1945.

48. *Clitocybe maxima* (Gart. & Meyer) Fr. On the ground, especially on moist cleared mountain sides. South Boulder Cañon Alt. 9,500–10,000 ft. July 22, 29, 1913. Nos. 1347, 1400.

A very large plant (up to 25 cm. broad) with thin depressed pileus, white in color. Clement's illustration (Minnesota Mushrooms, f. 12) shows the plant well.

49. *Clitocybe multiceps* Peck. On the ground. Boulder. Alt. 7,000 ft. June 22, 1914. No. 1821. Collected by E. Bethel.

The cespitose habit, large size, and the globose spores are the distinguishing characters.

50. *Clitocybe overholtsii* Murrill. On ground in coniferous forests. Tolland and South Boulder Cañon. July 22, 29, Aug. 1, 5, 1914. Nos. 1964, 2114. No. 2114 was designated by Murrill as the type collection of this species.

51. *Clitocybe tortilis* Fr. On ground. Boulder. Aug. 2, 1914. No. 2843. Collected by E. Bethel.

52. *Clitocybe vilescens* Peck? On the ground in grassland. Tolland. Alt. 9,000 ft. June 24, Aug. 4, 1914. Nos. 1820, 2111.

The small size (1–3 cm.), the dull cinereous color, the farinaceous taste, and the habitat appear to be the distinctive characters.

53. *Collybia acervata* Fr. On rotten wood. Tolland and Gilpin Saw Mill. Alt. 9,000–10,000 ft. July 29, August 2, 1913; July 27, 1914. Nos. 1391, 1996.

54. *Collybia amabilipes* Peck. On stumps or attached to buried wood. Tolland and South Boulder Cañon. Alt. 9,000–9,500 ft. July 3, 1913; July 8, 1914. Nos. 1278, 1888. *Collybia tenuipes* Schw. is said to be the same plant. As has been previously pointed out, the resemblance

of this plant to *C. velutipes* is close, and dried specimens of the two species are sometimes hard to distinguish.

55. *Collybia maculata* Alb. & Schw. On humus. Tolland. Alt. 9,000 ft. July 27, 1914. No. 1991.

56. *Coprinus atramentarius* (Bull.) Fr. On ground around stump. Tolland. Alt. 9,000 ft. July 3, 1914. No. 1277.

57. *Coprinus micaceus* (Bull.) Fr. On ground. Boulder. Alt. 7,000 ft. June 23, 1914. Collected by E. Bethel. No. 2848. Also collected by Dr. Ramaley at Tolland. June 26, 1911.

A third species of *Coprinus* was collected rather abundantly at Denver by Prof. Bethel, on stems of *Agropyron*, in June, 1914. The identity of the species has not been established.

58. *Cortinarius*[3] *argentatus* Fr.? On ground in coniferous forests. South Boulder Cañon. Alt. 9,000 ft. July 8, 1914. No. 1885.

59. *Cortinarius cinnamomeus* Fr. On ground in coniferous forests, aspen thickets, and under willows. Tolland. Alt. 9,000 ft. July 18, 1913; July 14, 1914. Nos. 1324, 1911, 1912.

An abundant species, and edible.

60. *Cortinarius concinnus* P. Karst. On grassy ground among willows. Boulder Park. Alt. 9,000 ft. July 14, 22, 1914. Nos. 1913, 1965.

Abundant in 1914. Characterized by the color, which is brick-red, ferruginous, or almost blood-red.

61. *Cortinarius corrosus* Fr.? On the ground in coniferous forests. Jennie Creek. Alt. 9,000 ft. July 20, 27, 1914. Nos. 1943, 1998.

62. *Cortinarius decoloratus* Fr. On the ground in coniferous forests. Tolland. Alt. 9,000 ft. July 28, 1913. No. 1377.

63. *Cortinarius glandicolor* Fr. On the ground in coniferous forest. Jennie Creek. Alt. 9,000 ft. July 27, 1914. No. 1990.

64. *Cortinarius herepeticus* Fr.? On the ground in coniferous forests. Tolland. Alt. 9,000 ft. July 28, 1913. No. 1378.

65. *Cortinarius malicorius* Fr. On the ground in coniferous forests. Jennie Creek. Alt. 9,000 ft. June 17, 1914. No. 1764.

66. *Cortinarius mucifluus* Fr. On the ground in aspen thickets. Tolland. Alt. 9,000 ft. July 25, August 3, 1914. Nos. 1982, 2096.

67. *Cortinarius psammocephalus* Fr. On the ground under pines. Tolland. Alt. 9,000 ft. Aug. 3, 1914. No. 2092.

68. *Cortinarius rusticus* P. Karst. On the ground in coniferous forest. Jennie Creek. Alt. 9,000 ft. July 20, 1914. No. 1951.

In point of numbers this seems to be the largest genus in the Colorado fungous flora. In addition to the collections cited above there are about 25 collections of unidentified material in the writer's herbarium.

69. *Flammula penetrans* Fr. On rotten coniferous wood in pine woods. Tolland. Alt. 9,000 ft. July 29, 1914. No. 2070.

70. *Flammula spumosa* Fr. Usually on buried wood, especially in old corduroy roads. Also on logs. Golden, South Boulder Cañon, Tolland. Alt. 7,000–10,000 ft. June 15, 19, 21, 28, 1913; June 14, 25, July 2, 5,

[3] All determinations in this genus were made by Dr. C. H. Kauffman.

7, 12, 1914. Nos. 1299, 1330, 1339, 1372, 1747, 1825, 1848, 1857, 1867, 1892.

Very abundant, especially after July rains. Edible.

71. *Hebeloma album* Peck. On ground in aspen thicket. Tolland. July 29, 1913. No. 1402.

This collection agrees well with the type specimens at Albany.

72. *Hebeloma crustuliniforme* (Bull.) Fr. On ground in aspen thicket. Tolland. Aug. 3, 1914. No. 2091.

73. *Hygrophorus conicus* (Scop.) Fr. On ground on rocky grassy slopes after heavy rains. Tolland. June 26, 27, 1913; July 13, 24, 1914. Nos. 1264, 1265, 1362, 1900.

Easily recognized by the bright-red conical pileus that in drying generally becomes blackish.

74. *Hypholoma incertum* Peck. On grassy ground. Boulder and Denver. May, July, 1914. Collected by E. Bethel. Nos. 1772, 2838. Also collected by Dr. Ramaley at Boulder, July 20, 1913.

75. *Hypholoma fasiculare* Huds. Attached to buried wood, on stumps, or apparently on the ground. South Boulder Cañon. Alt. 9,000–9,500 ft. July 29, 1913; July 12, 1914. Nos. 1397, 1895.

76. *Lactarius*[4] *alpinus* Peck. On ground in aspen thickets. Tolland. Aug. 1, 1913. No. 1413.

77. *Lactarius aspidioides* Burlingh. On ground under willows. Tolland. July 22, 1914. No. 1955.

78. *Lactarius cilicioides* Fr. On ground in aspen thickets and under pines. Tolland. Alt. 9,000–9,500 ft. July 29, 1913; July 29, 1914. Nos. 1392, 2081. Dr. Ramaley also collected it in South Boulder Cañon, August 31, 1912.

79. *Lactarius deliciosus* (L.) Fr. On ground in coniferous forests, especially on sandy slopes. Tolland and South Boulder Cañon. July 15, 1913; July 17, 29, August 5, 1914. Nos. 1913, 1927, 2062, 2123.

80. *Lactarius helvus* Fr. On ground in coniferous forests. Tolland. July 28, 1913. No. 1380.

81. *Lactarius lividorubescens* (Batsch.) Burlingh. On ground in aspen thickets. Tolland. Aug. 3, 1914. No. 2085.

82. *Lactarius parvus* Peck. On mossy bank by stream. Tolland. July 5, 1913. No. 1284.

83. *Lactarius subdulcis* Bull. On the ground in coniferous forests. Tolland. July 16, 30, 1913. Nos. 666, 1309.

84. *Lentinus lepideus* Fr. On railroad ties, coniferous logs and stumps, bridge timbers etc. Tolland and South Boulder Cañon. June 27, July 4, 13, 22, 31, 1913; June 2, 25, July 8, 12, 16, 1914. Nos. 665, 667, 1270, 1279, 1292, 1349, 1819, 1826, 1897, 1916.

85. *Lepiota granulosa* (Batsch) Gray. On ground in coniferous forests, especially in clearings. Tolland and South Boulder Cañon. July 30, 1913; July 21, 22, Aug. 5, 1914. Nos. 1337, 1406, 1906, 2115.

86. *Lepiota naucina* Fr. In dry grassland. Tolland. Aug. 4, 1914. No. 2108.

[4] All determinations in this genus were either made or verified by Miss G. S. Burlingham.

87. *Marasmius androsaceus* (L.) Fr. Among needles of lodge-pole pines. Tolland. July 16, 1913; July 20, 1914. Nos. 1305, 1936.

88. *Marasmius rotula* (Scop.) Fr. On rotten wood. Boulder. Aug. 2, 1914. Collected by E. Bethel. No. 2836.

89. *Marasmius semihirtipes* Peck. Among pine needles in coniferous forests. Tolland. July 16, 24, 1903; July 20, 1914. Nos. 1304, 1355, 1937.

90. *Mycena pura* (Pers.) Fr. On ground in coniferous forests. Tolland and South Boulder Cañon. July 20, 22, 1914. Nos. 1935, 1962.

91. *Omphalia campanella* (Batsch) Fr. On rotten logs of conifers. Golden, Tolland, and South Boulder Cañon. Alt. 7,000 to 9,500 ft. June 14, 17, 19, July 22, 1914. Nos. 1751, 1777, 1790, 1963.

92. *Pholiota acericola* Peck. On old logs and on the ground. Tolland. July 7, 1914. No. 1866.

93. *Pholiota howeana* Peck. On ground in dry coniferous forest. Tolland. June 26, 1913. No. 1256.

94. *Pholiota marginella* Peck. On dead coniferous timbers and on sawdust heaps. Tolland, South Boulder Cañon, and Gilpin sawmill; altitude 9,000 to 10,000 ft. June 26, July 1, 8, 1913; June 17, 18, 30, July 2, 1914. Nos. 1261, 1274, 1765, 1778, 1779, 1784, 1831, 1847.

I have referred here the common small yellowish-brown *Pholiota* so abundant on old coniferous logs in that region. It differs from *P. marginata* in having smaller, smooth, thin-walled spores and lacking cystidia. The spores of the latter species are much darker due to the heavy wall that is slightly roughened. *P. unicolor* is a related species with hymenial characters as in *P. marginata* but with a well developed persistent annulus. The spores of *P. marginella measure* 6–9 × 3.5–5 μ. Those of the other two species measure 8–10 × 5 μ.

95. *Pholiota praecox* (Pers.) Fr. On the ground in grassy places and in open coniferous forests. Tolland, South Boulder Cañon, and Lake Eldora. June 25, 26, July 4, 18, 21, 1913; June 25, July 19, 1914. Nos. 1253, 1267, 1316, 1343, 1797, 1824, 2308, 2329.

96. *Pholiota vermiflua* Peck. In grassy ground. Denver. May, 1914. Nos. 1771, 1773. Collected by E. Bethel.

97. *Pleurotus ostreatus* Jacq. On dead wood. Tolland. June 27, 1913; July 29, 1914. Nos. 1269, 2064.

98. *Pluteus cervinus* (Schaeff.) Fr. On ground rich in humus. June 27, 1913; July 12, 1914. Nos. 1260, 1893.

99. *Russula*[5] *abietina* Peck. On moist ground in coniferous forests. Tolland and South Boulder Cañon. July 16, 30, 1913. Aug. 5, 1914. Nos. 1306, 1403, 2117.

100. *Russula alutacea* Fr. On ground in coniferous forests. Tolland and South Boulder Cañon. July 24, 1913; Aug. 3, 4, 5, 1914. Nos. 1359, 2097, 2105, 2106, 2116, 2124.

101. *Russula atroviolacea* Burlingh. On ground under willows. Tolland. July 14, 1914. No. 1909. This collection was made the type of a new species by Miss Burlingham.

102. *Russula betulina* Burlingh. On ground in aspen thickets or under pines. Tolland, July 25, Aug. 3, 1914. Nos. 1978, 2084, 2094.

[5] All determinations in this genus were made by Miss G. S. Burlingham.

103. *Russula chamaeleontina* Fr. On ground in coniferous forest. Tolland. July 18, 1913. No. 1315.

104. *Russula consobrina* Fr. On ground in coniferous forests. Tolland. July 28, 1913. No. 1386.

105. *Russula emetica* Fr. On ground in coniferous forests. South Boulder Cañon. Aug. 2, 1913. No. 1423.

106. *Russula fallax* Fr. On ground under willows. Tolland. July 8, 1914. No. 1883.

107. *Russula flava* Romell. On ground in aspen thicket. Tolland. July 24, 1913. No. 1365.

108. *Russula nigrodisca* Peck. On mossy decayed logs in aspen thickets. Tolland. Aug. 1, 1913; July 25, 1914. Nos. 1411, 1983. The type collection of this species was collected on St. Paul Island, Behring Sea, and otherwise the species is only known from Colorado and Vermont.

109. *Russula subolivascens* Burlingh. On ground in aspen thicket. Tolland. Aug. 3, 1914. Nos. 2083, 2089.

110. *Russula raoultii* Quél. On ground in mixed forest. Tolland. July 27, 1914. No. 1988.

111. *Russula squalida* Peck. On ground in aspen thicket. Tolland. Aug. 3, 1914. No. 2088.

112. *Russula subalutacea* Burlingh. On ground in mixed forest or under pines. Tolland. July 24, 1913; July 27, Aug. 3, 4, 1914. Nos. 1363, 1987, 2093, 2104.

No. 2093 has been made the type collection for this species by Miss Burlingham.

113. *Russula turci* Bres. On ground in coniferous forest. Tolland. July 28, 1913. No. 1389.

114. *Russula xerampelina* Fr. On ground at edge of pine forest. Tolland. July 24, 1913. No. 1364.

115. *Panaeolus retirugis* Fr. On ground in path. Tolland. July 4, 1914. Collected by Miss Helen Leonard. No. 1854.

116. *Stropharia semiglobata* (Batsch.) Fr. On horse dung. Tolland. July 12, 19, 1914. No. 1899, 1930.

117. *Tricholoma praemagna* Murrill. On ground in dry grassland. Tolland. June 27, 1913; July 22, Aug. 5, 1914; May, 1917. Nos. 1268, 1972, 2121, 3908.

This is the fungus that causes the formation of the conspicuous fairy rings in open grasslands of this region. For an account of these see Ramaley, F., Torreya **16**: 193–196. 1916. The fungus is used as an article of food in this locality.

8. FAMILY BOLETACEAE

118. *Boletinus pictus* Peck. On ground in pine woods. Tolland. Alt. 9,000 ft. July 27, 1914. No. 1999.

119. *Boletus brevipes* Peck. On ground in coniferous forests. Especially on sandy ground. Under lodge-pole pines. Tolland. Alt. 9,000 ft. June 26, 1913; June 12, July 2, 29, 1914. Nos. 1815, 1851, 2063, 2312.

Dr. Murrill refers this species to *B. granulatus* but his description of that species does not fit these collections as well as does Peck's description of *B. brevipes.*

120. *Boletus edulis* (Bull.) Fr. On the ground in coniferous forests. Tolland. Alt. 9,000 ft. July 17, August 4, 1914. Nos. 1926, 2107.

121. *Boletus granulatus* (L.) Fr. On the ground in coniferous forests. Tolland. Alt. 9,000 ft. June 25, 1913; July 20, 1914. Nos. 1940, 2328.

122. *Boletus hirtellus* Peck. On the ground in the upland lodge-pole pine forests. Tolland. Alt. 9,000 ft. Aug. 6, 1914. No. 2057.

This species is a very beautiful one with a lemon yellow pileus thickly adorned with small tufts of hair. It is quite abundant after the July rains.

123. *Boletus scaber* Fr. On ground, usually in aspen thickets. Rollinsville, Tolland and South Boulder Cañon. June, July, and August. Nos. 1812, 1856, 1917, 1827, 1859, 2424, 2038.

The species is very abundant, and of all the collections made only one was from the coniferous forest floor. Its usual habitat is grassy aspen thickets. The pileus of one specimen measured 26 cm. in diameter. The color is very variable, from white to tan, brown, or red. Edible.

9. FAMILY POLYPORACEAE

124. *Favolus canadensis* Klotzsch. Boulder. Alt. 7,000 ft. On dead chokecherry. July 1, 1914. Collected by E. Bethel. No. 2832.

125. *Fomes fulvus* (Scop.) Gill. On *Prunus americana.* Boulder. Alt. 7,000 ft. June 24, 1914. Collected by E. Bethel. No. 2833.

126. *Fomes pini* (Thore) Lloyd. On coniferous trees and logs. Tolland, South Boulder Cañon and Lake Eldora. Alt. 9,000–9,500 ft. June 30, July 7, 1913; June 29, July 3, 4, 19, 28, 1914. Nos. 632, 642, 1844, 1877, 2018, 2033, 2391.

127. *Fomes pinicola* (Sw.) Cooke. On coniferous trees and logs. Tolland and South Boulder Cañon. Alt. 9,000–10,000 ft. June 23, 29, July 1, 1913; July 7, 1914. Nos. 645, 1875, 2005, 2402.

128. *Lenzites saepiaria* (L.) Fr. On coniferous logs. Tolland. June 29, 1913; July 7, 1914. Nos. 1878, 2313.

129. *Polyporus abietinus* (Dicks.) Fr. On coniferous logs. Tolland. June 30, July 8, 1913. Nos. 2001, 2007.

The former collection is of the sub-lamellate type of the plant, which is common in the east but more rarely found in the west.

130. *Polyporus adustus* (Willd.) Fr. On stump of *Pinus.* Tolland. June 17, 1914. No. 1780. An unusual host for this species.

131. *Polyporus alboluteus* Ellis & Ev. On coniferous logs mostly at high elevations (9,000 to 10,000 ft.). Tolland and South Boulder Cañon up to timber line. June 29, July 1, 1913; June 21, 25, 30, 1914. Nos. 629, 641, 1807, 1830, 1832.

A common orange red species often more or less resupinate.

132. *Polyporus confluens* Fr.(?). Collected by Dr. Ramaley at Boulder, Aug. 30, 1913.

This species is incorporated with some misgiving. The collection

consists of 8 or 10 plants preserved in formaldehyde. Undoubtedly most of the original color is lost, but there is a decided red or yellowish red tint to stems and tubes of some specimens.

133. *Polyporus elegans* (Bull.) Fr. On rotten wood. Tolland. July 24, 1913. No. 2027.

134. *Polyporus leucospongia* Cooke & Harkness. On coniferous logs at elevations of 9,000 to 11,000 ft. Tolland and South Boulder Cañon up to timber line. June 29, July 13, 1913; June 25, 29, 30, July 2, 1914. Nos. 643, 644, 1828, 1840, 2353, 2388.

A soft, pure white, sessile species. Rather abundant.

135. *Polyporus pargamenus* Fr. On dead *Populus*. Golden. June 14, 1914. No. 1756.

This collection represents the thick form of the species, more or less characteristic of the plant when growing on this host, and described by Murrill as *P. subchartaceus*.

136. *Polyporus perennis* (L.) Fr. On ground under pines. Tolland. Aug. 3, 1914. No. 2099.

137. *Polyporus ursinus* Lloyd. On pine logs. Tolland. July 18, 1913. No. 2016. I am indebted to Mr. C. G. Lloyd for the determination of this and the following species.

138. *Polyporus varius* Fr. On various kinds of dead wood. Tolland. June 20, July 7, 20, 1914. Nos. 1818, 1876, 1947.

This species is a close relative of *P. elegans*, having the general colors and the blackened stem of that plant.

139. *Trametes carnea* Fr. On coniferous wood. Golden. June 14, 1914. No. 1760.

140. *Trametes peckii* Kalchbr. Substratum unreported. Denver June, 1914. No. 1774. Collected by E. Bethel.

141. *Trametes protracta* Fr. On coniferous logs. Tolland. June 18, July 2, 1914. Nos. 1793, 1852.

This plant is by some regarded as the trametoid form of *Lenzites saepiaria*.

142. *Trametes serialis* Fr. On dead wood. Tolland. June 18, 1914. No. 1789.

10. FAMILY LYCOPERDACEAE[6]

143. *Bovista plumbea* Pers. On ground in dry grassland. Tolland. July 29, 1913; July 8, 1914. Nos. 1889, 2037, 3184.

144. *Calvatia caelata* Bull. On ground in open grassland or in thin forests. Tolland. July 8, 1913; June 16, 1914. Nos. 1742, 2006.

145. *Calvatia lilacina* Berk. On ground in dry grassland. Tolland. Aug. 4, 1914. No. 2102.

146. *Lycoperdon cepaeforme* Bull. On ground in pine woods. Tolland. July 29, 1914. No. 2075.

147. *Lycoperdon cruciatum* Roth. On ground in dry grassland or in thin woods. Tolland. July 29, Aug. 3, 1914. Nos. 2076, 2103.

[6] All determinations in this family were either made or verified by C. G. Lloyd.

148. *Lycoperdon gemmatum* Batsch. On ground in thin forests and in dry grassland. July 29, Aug. 3, 1914. Nos. 2077, 2087.

149. *Lycoperdon umbrinum* Pers. On ground in coniferous forests. South Boulder Cañon. July 8, 1914. No. 1881.

150. *Secotium acuminatum* Mont. On ground in dry grassland. Tolland. July 29, 1913. No. 2036.

12. FAMILY NIDULARIACEAE

151. *Cyathus vernicosus* DC. On old paper along stream in coniferous forest. Jennie Creek. Altitude 9,000 ft. July 7, 1914. No. 1873.

12. FAMILY PHALLACEAE

152. *Phallus impudicus* L. On the ground. Boulder. June 23, 1914. Collected by E. Bethel. No. 2859. Also collected by Dr. Ramaley at Boulder, May, 1912.

It is worthy of special note that both these collections were made in the spring. The specimens were in good condition and some were in the egg stage.

STATE COLLEGE, PA.

A NEW BALANSIA ON CYPERUS

C. W. Edgerton

(With Plate 12)

During the summer of 1917, an interesting species of *Balansia* was found attacking the fruiting parts of *Cyperus virens*. The fungus seemed to be of special interest as the described species of this genus are mostly listed as occurring on grasses. The region in which the specimens were found consisted of a low swampy sedge meadow in which *Cyperus virens* made up a considerable portion of the plant population. A large portion of the sedge plants of this species were attacked by the fungus. The fungus formed large black sclerotia in place of the fruiting parts, and as *Cyperus virens* is one of the very large sedges, diseased plants were very conspicuous. Specimens in all stages of development were found in abundance.

Cyperus virens develops in large stools often with fifteen to twenty or more flower stalks and it was interesting to note that a stool was either entirely healthy or else all of the flower stalks were diseased. Although a careful search was made, no stools were found which contained both healthy and diseased flower clusters. This held true even though the stools were touching each other or were interlaced. This seemed to show that the infection must have occurred very early in the development of the host plant or else the mycelium of the fungus was perennial.

The fungus is easily demonstrated in the very young flower buds. The young bud which would normally develop into a whole flower cluster is at first enclosed by the large leaves. A bud from a diseased stool has the appearance of being perfectly healthy, yet a cross section shows the mycelium to be abundant between the different parts. The host cells, however, do not appear to be injured in these very small buds. Buds were examined that were less than two millimeters in diameter.

The fungus sclerotium develops as the bud enlarges and emerges from the covering leaves. The mycelium develops within the bud and also forms a white layer over the outside (Fig. 1). On this white layer the conidial stage of the fungus develops. The short and narrow conidiophores form a very dense layer from forty to fifty microns thick over the surface of the sclerotium. The small hyaline conidia develop very abundantly often collecting in mucilaginous drops on the surface.

Following the conidial stage, the sclerotium continues to increase in size, turns black in color, and the exterior mycelial layer increases in thickness. The mature sclerotium (Fig. 3) consists of a mass of small nodules each representing one of the stems of the flower cluster. Sometimes these nodules are more or less separate but generally they are all cemented together in one mass. Frequently on drying, these separate to some extent. The interior of the sclerotium is typical of this genus, it being composed of both fungous and host tissues.

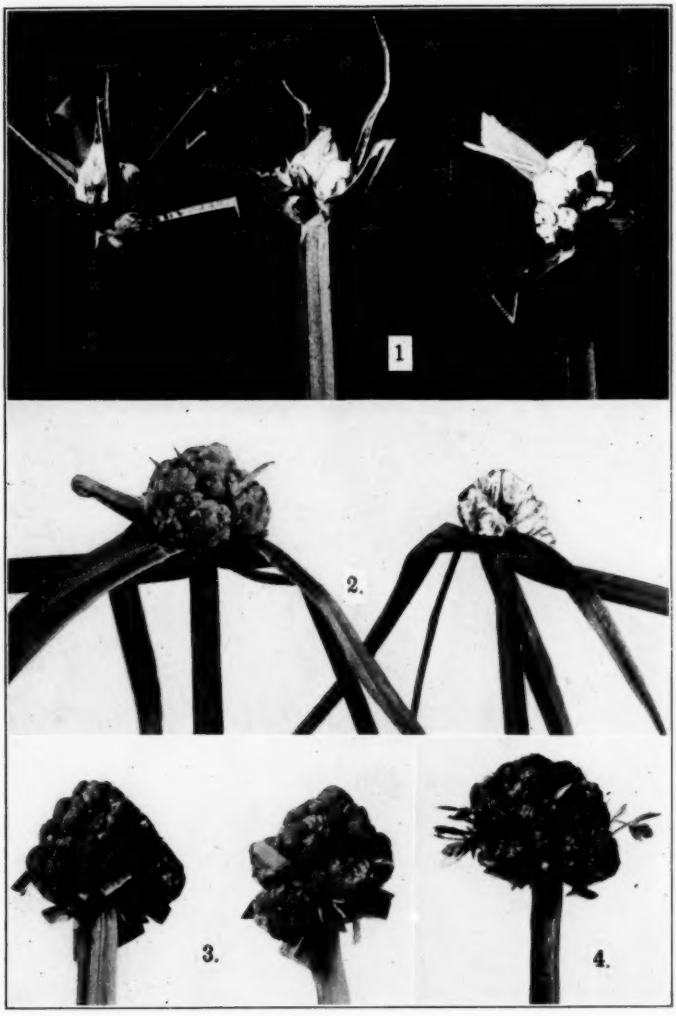
The perithecia of the fungus form in the black outer layer of the mature sclerotium. They are embedded in the tissue with only the ostioles extending slightly above the surface. The ascus has the peculiar bulbous apex found in other species of this genus.

Very seldom is there any development of the parts of the flower cluster of infected plants, though occasionally a stalk or two will push out of the sclerotium for a short distance and form rudimentary spikelets (Fig. 4). Sometimes when this happens, a secondary sclerotium will develop on this branch.

Specimens of this fungus were sent to the late Professor G. F. Atkinson, who had made considerable study of this genus, and he stated that it was undoubtedly an undescribed species. The technical description of the fungus follows.

Balansia cyperi sp. nov.

Sclerotium made up of fungous and host elements, developing in the flower cluster; sometimes one for each branch of the cluster but generally a large, compound, nodose sclerotium in place of the whole flower cluster; slightly stipitate or sessile, 1–3 cm. in diameter, white to greyish in color during early development, but black, hard and papillate at maturity. Conidia developing on



BALANSIA CYPERI EDGERTON

short narrow, crowded conidiophores on the white immature sclerotia, straight or slightly curved, long, narrow, sharp pointed, hyaline, 15–30 × 1–1.8 μ. Perithecia flask shaped with a somewhat thickened elongate neck extending to the surface of the sclerotium, 480–600 × 120–200 μ. Asci long, narrow, usually straight but sometimes curved, 160–225 × 7–10 μ. Ascospores long, narrow, hyaline, septate, 100–200 × 1.5–2 μ.

In fruiting parts of *Cyperus virens,* St. Gabriel, Louisiana, August 16, 1917, collected by A. T. Bell and C. W. Edgerton.

Type material in Herbarium of the New York Botanical Garden. Specimens also in Bureau of Plant Industry collections, Washington, D. C.

LOUISIANA AGRICULTURAL EXPERIMENT STATION,
BATON ROUGE, LA.

EXPLANATION OF PLATE 12

Balansia cyperi on *Cyperus virens*

Fig. 1. Young immature sclerotia with conidial stage.
Fig. 2. Older stage of sclerotia.
Fig. 3. Mature sclerotia with perithecial stage.
Fig. 4. Mature sclerotium with rudimentary spikelets of the host plant.

AN UNDESCRIBED TIMBER DECAY OF HEMLOCK

ERDMAN WEST

For several years, dead hemlock timber in the vicinity of State College, Pennsylvania, has been destroyed by a peculiar rot which seems to be quite constantly associated with sporophores of the fungus *Polyporus tsugae* (Murrill) Overholts. An investigation of the problem was undertaken at the suggestion of Dr. L. O. Overholts and a preliminary report of the situation prepared but not published. Soon after assuming his duties in New Jersey, the writer noticed a group of hemlocks along the Raritan River near New Brunswick, N. J. An excursion to these showed a large number of them dead or dying from the effects of the root rot fungus *Polyporus schweinitzii*. Some of the trees bore sporophores of the sap rot *Polyporus abietinus*, but most of the trees that had died recently, bore sporophores of *Polyporus tsugae*, sometimes in great abundance. Further investigation showed present in these standing trunks the same rot that had been studied in stumps and prostrate trunks of hemlock near State College. This abundant material has made further observations possible.

Polyporus tsugae (Murrill) Overholts has been reported on pine and hemlock for a number of years but the decay caused by it has never been described. The sporophore was first described by Dr. W. A. Murrill under the present specific name. He placed it in the section *Fomiteae* under the name *Ganoderma tsugae* along with several other species of *Ganoderma*. It is, however, an annual plant and the entire genus as limited by Dr. Murrill more properly belongs in the section *Polyporeae* instead of *Fomiteae*. This point will be given further consideration later. The species has also been referred to the genus *Polyporus* by another writer. The species is very closely related to *Polyporus lucidus* and *P. curtisii*.

Mr. C. G. Lloyd has repeatedly stated in his writings that *P. tsugae* is *not* a good species but only the coniferous wood form of *P. lucidus*. A careful examination, however, shows differences[1] that are sufficient to warrant its being retained as a separate species. First, the context in *P. lucidus* and *P. curtisii* is made up of two layers, the upper one quite whitish and the lower having brown hyphae running all through it, so that to the naked eye it appears brown; in *P. tsugae* on the other hand, the context is never duplex and does not have the brown hyphae, so that the context is light and concolorous from crust to tubes. The difference is very apparent when the pilei are cut vertically and compared. The red varnishing of the pileus is also very characteristic. In *P. lucidus* and especially in *P. curtisii* the red color fades into yellowish brown in spots in almost every specimen, such spots being of a dull color. In *P. tsugae* the pileus is of a dark red or mahogany color all over, with a bright glossy surface. This distinction holds good even in old herbarium specimens if mature when collected. Under the microscope, the type of the hyphae is a distinguishing character. In *P. lucidus* and *P. curtisii* the hyphae are rather slender, being about 4–10 microns in diameter on the average. The hyphae in these two species are not very abundantly branched though they cannot be said to be unbranched by any means. In *P. tsugae* there are slender hyphae but they are always abundantly branched. Besides there are numerous short thick hyphal elements that may be as high as 15 microns in diameter and of very various lengths. These have many small branchlets coming off at various points with many of these lateral hyphae branching several times and terminating abruptly near by. This branching is very conspicuous under high power of the microscope where hardly a hypha will cross the field without branching at least once, while in the other two species, unbranched hyphae crossing the field of vision were relatively frequent. The host may also serve as a guide to the species since *P. lucidus* and *P. curtisii* are, as far as the writer could find, always found on hardwoods, while *P. tsugae* is confined to coniferous wood, especially hemlock.

[1] Ann. Mo. Bot. Gard., 2, 1915. Comp. Studies Polyporaceae. Overholts.

As mentioned above, these three species have usually been grouped as a part of the genus *Polyporus,* or if given specific rank, placed in the section with *Fomes* as an exception to the perennial character. There is perhaps sufficient reason for giving this group specific rank, for the red varnished pileus, and the truncate, apparently echinulate spores are definite and fixed characters. The spores are especially exceptional. They appear to be echinulate, but closer examination shows, as Professor Atkinson pointed out, that the roughening is a sculpturing of the inner side of the spore-wall and not the outer as in the first impression. The species may be dscribed as follows:

POLYPORUS TSUGAE (Murrill) OVERHOLTS[2]

Pileus reniform or flabelliform, short stipitate when attached to trunks or stumps above ground level, longer stipitate when attached to roots, 5–15 × 6–20 × 1–4 cm., with a mahogany colored or almost black, shining encrusted surface, glabrous, sulcate; context white or nearly so throughout, .5–2 cm. thick; tubes .5–1 cm. long, mouths white or brown, averaging 4–6 per mm.; stem lateral with color and context as in pileus, 3–15 cm. long, 1–3 cm. thick; spores ovoid with a truncate base, apparently echinulate, light-brown, 9–11 × 6–7 μ; hyphae very irregular and much branched up to 15 μ in diameter.

On standing or prostrate trunks, stumps, or exposed or nearly exposed roots of hemlock, *Tsuga canadensis,* probably with a range of its hosts. Occasionally on pine.

It has been reported from Vermont, New Hampshire, Massachusetts, New York, New Jersey, Pennsylvania, Ohio, West Virginia, and North Carolina.

The fungus is at first a sap-rot but it eventually destroys the heart-wood also. Near New Brunswick, a partly uprooted and leaning trunk 14 inches in diameter was entirely destroyed by this rot. Few stumps or dead trunks escape its attacks when it is present in a locality and since it is quite rapid in its work, it is a potential source of danger to stored hemlock lumber.

When first attacked, the wood turns a little darker in color and becomes dull and porous looking like a piece of fine grained blot-

[2] Polyporaceae Middle-Western U. S., L. O. Overholts. Washington University Studies, Vol. III, part I, No. 1. 1915.

ting paper. As the rot progresses, numerous checks or horizontal cracks appear. These do not appear to be due to shrinkage but rather to have been dissolved out by the action of the hyphae. They extend individually only through a single layer of springwood, but in the later stages of the decay, short vertical cracks connect the horizontal and a complete network is formed which becomes completely filled with white mycelium. The wood at this stage splits very easily along the annual rings into concentric layers. On the inner side of these layers, the network of cracks filled with the white mycelium, shows up very conspicuously. At the same time or a little before, numerous black dots make their appearance at irregular intervals throughout the decayed wood. They increase in number and sometimes form lines as the wood goes into the later stages of decay. They are more or less distinct in outline and are harder than the surrounding wood. They vary slightly in color but are usually so dark a brown that they appear black to the unaided eye. They are usually not more than a few millimeters in any dimension.

The fungus is primarily a cellulose destroyer but soon attacks lignified structures also. The mycelium attacks first the medullary rays and partially destroys them. All free cellulose is absorbed at this stage since various tests for it gave negative results in the rays and traceids alike. The fungus now fills the ray cavities with a mass of tangled hyphae, frequently containing some of the thick elements found in the context of the pileus. At this same time it attacks the tracheids, starting at the bordered pits. These are eaten out until only irregularly shaped holes remain. The hyphae may now pass easily from one tracheid to the next by simply dissolving a hole in the wall. The hyphae branch freely throughout the wood and seldom pass from one ray to the next without doing so. Clamp connections are very abundant and seem to be the rule. Occasionally they occur at branches and cause the mycelium to appear swollen at the joints, which is not really the case. As a rule the hyphae are hyaline, slender, 4–8 μ in diameter, except in the rays mentioned above, and are filled with many small oil globules. However where the black spots appear, the hyphae are often thicker and shorter jointed

and have a brown color. The brown color is due to the presence of small brown globules possibly of some substance from the wood, toxic to the fungus and isolated in these spots.

Chemical tests used to detect the presence of cellulose:

1. Iodine in KI solution followed by treatment with weak sulfuric acid (1–3) colors cellulose blue;

2. Chloriodide of zinc colors cellulose blue;

3. Iodine in alcohol colors cellulose faintly yellow.

Of lignin:

1. Iodine in alcohol colors lignin deep yellow;

2. Phloroglucin followed by hydrochloric acid colors lignin bright carmine red wherever present;

3. Carbolic acid and hydrochloric acid followed by exposure to daylight for an hour color lignin green.

The use of these tests showed the removal of the cellulose from the rays in the early stages. Soon afterward, however, the tracheids in the spring wood were attacked and the middle lamella laid bare, so that a test at just the right stage indicated a small amount of free cellulose present here. As the rot progressed, tests for cellulose failed altogether, and those for lignin grew fainter. However, phloroglucin and hydrochloric acid indicated a small amount present in the most rotten wood. This action of the fungus indicates that it secretes both lignin and cellulose dissolving enzymes during its development.

In some respects the rot is very similar to that caused by *P. borealis* in the same host. As that seems to have the checks in the spring wood also, the presence of the before mentioned black spots and lines in the case of the decay caused by *P. tsugae* is the chief means of identification when sporophores of the fungus are not present.

The rot can usually be detected, in the older stages at least, by the presence of the sporophores with their very glossy red surface and the white context from the crust to the tubes. The rot in the wood is characterized by its being primarily a sap rot (though it finally rots the heart-wood also) producing a porous condition, with numerous white checks in the spring-wood and blacks spots scattered through the rotted area.

NEW BRUNSWICK, N. J.

PINEAPPLE FUNGUS OR ENFANT DE PIN OR WABADOU

J. H. Faull

"There groweth also upon the larch tree a kind of mushrum or excrescence, not such as is upon other trees, but whiter, softer, more loose and spongie than any other of the mushrooms, and good for medicine, which beareth the name of *Agaricus* or Agaricke." In these words Gerard, in his Herbal (1597) for English readers prefaced his account of the polypore, *Fomes officinalis* (Vill.). This fungus grows on the larches, *Larix europaea* and *L. sibirica,* in many parts of Europe and Asia, and according to Marie[1] on the cedar of Lebanon in northern Africa. Comparatively recently it was discovered by botanists in America where it is now known to occur widely distributed and on at least sixteen species of coniferous hosts distributed among the genera *Abies, Picea, Larix, Tsuga, Pinus* and *Pseudotsuga.*

To modern botanists *Fomes officinalis*[2] is of main interest because of its parasitism and the decay it produces in timber; but formerly, back to earliest times, it was considered almost solely because of its medicinal value. Dioscorides, Pliny, Galen, and their successors down to the beginning of the last century accorded it an important place in their writings on medicinal plants, and it was recommended by them in the treatment of nearly all the physical and the mental ills to which man is subject. There

[1] "Il a été retrouvé sur le cèdre par M. Trabut à Teniet-el-Had, et par nous-mêmes sur le Haizer. Ce champignon agit, par l'acide agaricinique qu'il contient, en paralysant les nerfs des glandes sudoripares, d'où son emploi pour combattre les sueurs profuses des tuberculeux. A la dose de 2–3 gr., le *P. officinalis* produit de la gastro-enterite; mais il n'y a pas à redouter d'empoisonnements par ce champignon, sa consistance ne permettant pas son emploi en dehors de la thérapeutique." Maire, R.: "Les Champignons vénéneux d'Algérie"—Bull. de la Soc. d'Hist. Not.: **7**: 203. 1917.

Cèdre—*Cedrus Libani* Barrel.

[2] Faull, J. H.: Fomes officinalis (Vill.), A Timber-destroying Fungus, Trans. Roy. Can. Inst. **11**: *pl. 18–25,* pp. 185–209. 1917. Full bibliography.

can be little question but that the knowledge of its powers was current among the inhabitants of Europe long before the era of materia medica and that many superstitions were associated with its use. But the history of *F. officinalis* in America is unknown, and because of this I venture to bring together a few fragments of information that have come to my hand.

Fomes officinalis grows on white pine (*Pinus Strobus*) practically throughout its range in Ontario and Quebec, and this is the only host that is definitely reported for these provinces. An Ojibway "medicine man," however, informed me that while commonest on white pine, he had also collected it from large tamaracks (*Larix laricina*) in the Georgian Bay Area, which seems quite probable as this host is recorded for Wisconsin, and hemlock (*Tsuga canadensis*), which, if so, is a new host, but never on red pine, jack pine, spruces, balsam, or arbor vitae. I could find no trace of it further north than within the southern limits of Temagami Forest Reserve, that is about 50 miles south of the northern range of *Pinus Strobus,* and even there it is rare, but from Georgian Bay, south and east it is so frequent as to be well-known to the Indians, lumbermen, and settlers both in Ontario and Quebec. With the cutting of the mature pine, however, specimens of the sporophores are no longer easily obtainable, and possibly at no time were abundant. According to the testimony of several people of whom inquiries were made, the fruiting bodies in some cases attain a very large size, up to 2 feet or more in length and of many pounds weight.

A plant so well-known was bound to receive a name; indeed, this plant bears at least three names, in as many different languages, and none of these even distantly resemble any of the common names employed in Europe. To the English settlers and lumbermen the punks of *Fomes officinalis* pass under the name "pineapple" or "pineapple fungus," to the French, "enfant de pin," and to the Ojibway Indians, "wabadou."

Elsewhere I have made a conjecture as to the origin of the term "pineapple," and have expressed the opinion that we have a retention here of a meaning akin to its original definition (pineapple tree was originally synonymous with pine tree, and meant

a tree on which pineapples, that is, cones grew). The French designation employs the word "enfant" in quite an ordinary sense, but its non-inclusion of other fungus growths on the pine indicates the special attention paid to this one. The Ojibway name "wabadou" is quite plainly a combination of the Indian "wab" which means white and "amadou,"[3] a French word for the tinder formerly made in Europe from the context of *Fomes fomentarius* and other bracket fungi, and still current among the French-Canadians for "punk." This derivation is all the more understandable when it is pointed out that all other fungus growths on trees without distinction are called "anadou"[4] by these Indians,—evidently a slightly corrupted form of "amadou" and an easy transition in application from tinder to the source of the tinder. To the Ojibways then the fruiting body of *Fomes officinalis* is simply "wabadou,"[5] contraction of wabamidou, that is *white tinder fungus*. It is interesting that the vocabulary of the Ojibways north of Lake Nipissing includes no names for any other species of fungi; so far as I could learn not one of the many species of mushrooms which in season abound in the forest is used by these Indians as food, and so there has been no occasion for enlarging their mycological nomenclature.

That the Indians have a special name for *Fomes officinalis* is good evidence of a long-standing use of this fungus aside altogether from certain superstitions held with regard to it, but this evidence is not sufficient proof that they knew of it prior to the coming of the Europeans, especially as the Indian name is evidently based on the French "amadou." The Georgian Bay country and eastward was much travelled over by French Jesuits, fur

[3] "Amadou" is of disputed origin. The most probable explanation is that it is derived from "amadouer" (Provençal) meaning to wheedle or coax (quite appropriately applied to a substance especially used for coaxing fire into being).

[4] In the closely related Cree language the names for "amadou" according to LaCombe are "pusagan," and "kutawagan."

[5] Through Mr. F. W. Waugh, I learn that there is an Ojibway word "wabado" meaning rhubarb—I presume the root of the medicinal Turkish rhubarb. As there is a similarity in taste and use of rhubarb and wabadou, it may be reasonably assumed that the term as applied to rhubarb is a borrowed one.

traders and coureurs de bois from Champlain's time and the Indians made annual visits to the French stations on the St. Lawrence many years prior to Champlain's explorations, so that it may well be that their first knowledge of it came from the French, some of whom would certainly be well acquainted with a plant so highly esteemed in European medicine at that time. It may be noted in passing, however, that Dr. D. Lyall, an English botanist attached to the British North American Boundary Commission, 1859–61, the discoverer of *F. officinalis* in America, reports that the Indians of British Columbia employed this fungus as a medicine. It is likewise interesting that *Fomes officinalis* was also probably employed by the Iroquois. Mr. F. W. Waugh, the author on an excellent work on "Iroquois Foods and Food Preparation" (Memoir 86, Geological Survey, Canada, 1916) writes me, "Among the Iroquois, the Cayuga, Mohawk, and probably other Iroquois tribes, a Fomes growing on *pine* is used as a medicine for a variety of diseases, reliance being placed on the supposed magical qualities of the fungus. Among the Onondaga it used to be shot with an arrow before being removed from the tree. It was prepared in the form of a decoction." Nevertheless, while it seems quite possible that the Indians knew of *F. officinalis* before the coming of the whites, no absolute proof has been yet adduced that such was the case. It may be that some one of the Jesuit Fathers has left a record that would furnish an answer to this question.

The Ojibway Indians still prize "wabadou" as a household remedy, considering it valuable for various internal complaints and at child birth. It is sometimes used dry, but is usually mixed with the sapwood of arbor vitae taken from "the south side of the tree" and boiled in water. The fruits, in the fanciful estimation of the Indians, are best when gathered in the spring, and in pulverizing should be scraped downward to be most efficacious. I learned from several independent witnesses that while the punks are of little value as charms and are sexless, yet they are surely living objects for they are reputed to change their position of their own accord, passing through the air from one tree to another, and moreover they make a sound (moaning or groan-

ing ?) somewhat like that of a man, by which means they are readily located in the still forest. Herbarium specimen No. 3525, University of Toronto Herbarium, is part of a large punk given to me by an Indian family at Bear Id., in Temagami Forest Reserve, which was located in this manner and shot down by two Indians on a hunting trip in the southern part of the Reserve about 25 years ago. As it is scarce on the Reserve a fragment is all they would willingly spare from their dwindling supply. How the punks originate and what their relation to the trees may be is a mystery. The Indians are certain they knew and used this plant long before the whites came, but, however that may be, it is certainly of great interest that their veneration of it finds a counterpart in the veneration manifested by the Europeans of more primitive days.

Mr. J. W. Bartlett, Superintendent of Algonquin Park, who has been intimately acquainted with the white pine areas of Canada for nearly half a century, informs me that it was well known to many of the early settlers and gathered by them for various purposes. He found it fairly common throughout the lumbering areas of Ontario and Quebec. Not only was it used medicinally but also in the making of home brewed beer, and as a substitute for hops in the making of yeasts. In the yeast making, the fungus was boiled as in the case of hops and the liquid put into the new yeast to "start it working," in fact it probably serves the same purpose as the lupulin of hops in holding bacteria in check and so giving the yeast a chance to grow. Mr. Bartlett learned of it from the settlers after he came to Canada more than fifty years ago but does not know the source of their information. A teacher in one of the mission schools in northern Ontario informed me that she had known of the "pineapple fungus" from earliest recollections and that it had been a household medicine in her home near Pembroke, Ontario. Her father would collect it in the forest when cutting the wood for the winter. It was regarded as especially valuable as a spring medicine and as such was copiously administered to the children in season. Similar information was received from various other persons in Ontario.

Mr. W. F. Atkinson, Forest Engineer for the Spanish River

Pulp and Paper Co., formerly of Quebec, and for many years associated with large lumbering interests there, was the first to inform me that the "pineapple" was well and widely known throughout the white pine belt of Quebec, but most commonly under the name "enfant de pin," and so far as he knew it grew on the white pine only. It is used by the habitants for various medicinal purposes and among others at child birth. The habitant, according to one of my French-Canadian informants, who himself carried a supply in his medicine cabinet, prepares the tonic by adding two tablespoonfuls of the powdered "enfant de pin" to a pint of gin; some of this, according to the age of the patient, diluted with water, makes a very efficacious remedy. This carries us back to Dioscorides, who concludes his discourse on "Agaricum," affirming that "On the whole, it is serviceable in all internal complaints when taken according to the age and strength of the patient; some should take it with water, others with vinegar and honey or with water and honey, and others with wine."

UNIVERSITY OF TORONTO,
TORONTO, CANADA.

NOTES AND BRIEF ARTICLES

[*Unsigned notes are by the editor.*]

Owing to the increased cost of publication, the price of MYCOLOGIA *will be advanced four dollars ($4.00) at the beginning of 1920. This price will also apply to back volumes; which can still be supplied in complete sets.*

Dr. Charles E. Fairman, of Lyndonville, New York, spent the first part of July studying certain collections of fungi in the herbarium of the Garden. He is preparing manuscript for *North American Flora.*

Mrs. Flora W. Patterson, mycologist of the Department of Agriculture at Washington, visited the Garden on June 24 for consultation regarding a group of fungi she is monographing for *North American Flora.*

Dr. C. T. Gregory, who for the past six months has been employed by the Department of Agriculture as extension pathologist in the control of truck crop diseases in Indiana, has accepted the position of plant pathologist of the Virginia Truck Experiment Station, Norfolk, Virginia.

Dr. M. F. Barrus has returned to Cornell University to resume his duties as plant pathologist after an absence of several months spent mainly in the employ of the Department of Agriculture as pathological adviser in extension work on the control of truck crop diseases in the North and West.

Dr. W. H. Tisdale, who left the Department of Agriculture a few months ago to become plant pathologist of the North Carolina Agricultural Experiment Station, has been reinstated and

will take charge of investigations of rice diseases, with headquarters in the Washington, D. C., laboratory.

A study of the relation of bacteria to cellulose fermentation induced by fungi with special reference to decay of wood, according to Henry Schmitz in the *Annals of the Missouri Botanical Garden* for April, shows that cellulose dissolving bacteria play no important part in the decay of wood under natural conditions. The rate of decay however is materially increased by the action of ordinary saprophytic bacteria. When autoclaved wood is used, the changes which it undergoes must be taken into consideration.—*F. J. Seaver.*

Mrs. M. F. Wheeler, curator in the department of botany of the Massachusetts Agricultural College, visited the Garden on June 25 and 27 to examine specimens of powdery mildews collected in Massachusetts. She is preparing a bulletin on this group of parasitic fungi to appear within a few months.

G. Arnaud, of the Station of Plant Pathology at Paris, has recently published an extensive work on the "Astérinées." The group as here considered not only includes most of the genera ordinarily included with the Perisporiales but many segregates from other orders and families. The entire work consists of 289 pages, 53 plates, a number of text-figures, and three maps. In addition to the systematic treatment, considerable space is devoted to climatology, geographic distribution, and the comparative morphology of the group.—*F. J. Seaver.*

A check list of the fungi of Porto Rico by Mr. John A. Stevenson, formerly pathologist in the Insular Experiment Station, has recently appeared. This list contains a record of all of the species of fungi and slime molds occurring in the island so far as known up to the date of publication. The species name is accompanied by the name of the host or substratum, the locality, and the collector when not collected by a member of the staff of the experi-

ment station. The entire work consists of 129 pages and is a valuable guide to the fungous flora of the island, as well as a basis for further study.—*F. J. Seaver.*

Dr. S. M. Zeller, who has been special investigator in timber pathology for the Southern Pine Association, of New Orleans, Louisiana, with a laboratory at the Missouri Botanical Garden, St. Louis, has been appointed investigator in fruit diseases at the Oregon Agricultural College, Corvallis, Oregon.

Bulletin 759 of the Bureau of Plant Industry, by Fred R. Jones, deals with the leaf-spot diseases of alfalfa and red clover caused by the fungi *Pseudopeziza Medicaginis* and *Pseudopeziza Trifolii* respectively. From his investigations he concludes that the two fungi are morphologically and physiologically distinct although they have been regarded by some as being identical. Of the several imperfect fungi which have been reported as the conidial stage of this fungus, none have been found to be related and no other spore form than the ascospore form apparently exists. Infection is produced by the direct penetration of the germinating ascospores through the cuticle and epidermal wall. The fungus overwinters on the dead leaves which escape decay and ascospores produced in the spring furnish the source of new infection.—*F. J. Seaver.*

In the report of the State Botanist of New York for 1917, just issued, Dr. H. D. House describes a new species of *Humaria* under the name of *Humaria Peckii.* The species occurs on decaying hay and is accompanied by a *Sclerotium.* In the same report a number of new species belonging to various groups are described by Dearness and House. The bulletin also contains an article by G. F. Atkinson on *Collybia campanulata* Peck and its near relatives in the eastern United States, and one by Dr. L. O. Overholts on the species of *Poria* described by Peck. The last article is illustrated by twenty-three plates.—*F. J. Seaver.*

Dr. Fred J. Seaver spent the first week of June at Ithaca, New York, collecting fungi in collaboration with Cornell University, the Brooklyn Botanic Garden, and Syracuse University. Three main excursions were made, one to Enfield Gorge, one to Laborador Lake, about forty miles from Ithaca, and one to the bogs of Mud Pond Basin near McLean. Other local trips were made in the gorges immediately adjacent to the college campus. Where necessary, transportation facilities were provided by the extension cars of the Agricultural College and the various trips were attended by a number of the graduate students and staff of the department of plant pathology under the direction of Professor H. H. Whetzel. While an exact count has not yet been made, the trip will probably add more than two hundred specimens of ascomycetes and parasitic fungi to our collection. No special attention was given to the higher fungi, since no one of the party was particularly interested in them.

METAPHANIC AND PROGRESSIVE VARIATION IN BEAUVERIA: ITS PHYLETIC SIGNIFICANCE

The fungi of the Conidiosporae class are subdivided into 4 groups from the spore formation: 1°, Sporotrichae, where mycelial hyphae directly yield conidia, 2°, Sporophorae, where conidia bud from sporophores, 3°, Phialidae, where conidia are formed from a differentiated bottle-like hypha called "phialida," and 4°, Prophialidae, where the phialides, instead of springing from undifferentiated vegetative hyphae, are only produced by peculiar hyphae termed "prophialides."

Daily observation of *Beauveria globulifera,* collected from mummified moths of *Cnethocampa pityocampa* in Arcachon, and cultivated in hanging drops, shows that spore formation, in this typical Philalidae, is at first a mere process of budding,—as in Sporophorae,—and differentiates to the complex conidial system of Prophialidae, as the cultures age.

1. So long as the cultures are less than 10 days old the end of the big mycelial hyphae may bud into great, oval, isolated conidia, as is only observed in Sporophorae.

2. In cultures 10 to 12 days old, undifferentiated cylindrical phialides form single, round, small conidia at the end of their thread-like summit.

3. The base of the phialide becomes swollen, while other conidia are formed basipetally below the terminal one, so that the phialide terminates into a zig-zag sporiferous thread as is typical in *Beauveria*.

4. The phialides may become forked, and yield several zig-zag sporiferous threads.

5. Phialides group by twos on vegetative hyphae, and the phialidiferous parts of the hyphae become swollen.

6. Typical phialides group into a glomerule at the end of a differentiated phialidiferous hypha, which may be termed a prophialide, such as exists in the Prophialidae.

Undifferentiated conidial threads have been interpreted by Vuillemin as regressive phialides in *B. Bassiana*. But it appears that all the conidial forms which we have recorded are normal phases of the ontogenic development of *Beauveria*, and they seem to be of phylogenetic significance, as they actually link the *Beauveria* both to the lower and to the higher Conidiosporae.[1]

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JEAN DUFRENOY

COLLECTING FUNGI IN VIRGINIA

During the latter half of July, 1919, the writer made a tour through parts of southwest Virginia, returning by way of Blue Ridge Springs, Bedford City, Lynchburg, and Falls Church. A drought early in the month was followed by over a week of rain, which brought out an unusually large and diversified crop of

[1] We are indebted to Professors A. Guilliermond and J. Beauverie for the determination of the *Beauveria* and helpful suggestions.

fungi. These were studied and collected for several days in the vicinity of Blacksburg, Virginia, at an elevation of 2,200 feet, where the woodlands are mostly oak-chestnut and the rocks Trenton limestones or subcarboniferous shales and sandstones.

Many of the gardens, vineyards, and orchards were severely injured by the rainy weather, various wilts and rots having developed in abundance. Trees were attacked by destructive polypores, among them *Bjerkandera adusta, Coriolus versicolor, Daedalea quercina, Elfvingia lobata, Fulvifomes Robiniae, Grifolia Berkeleyi, Laetiporus speciosus, Porodaedalea Pini, Trametes robiniophila,* and *Tyromyces Spraguei.* The most abundant of these were probably *Fulvifomes Robiniae* on black locust and *Elfvingia lobata* on various species of oak, hickory, and maple. This latter species seems to entirely take the place of *Elfvingia megaloma* in that section, and its annual habit and other distinguishing characters are plainly marked.

The forest floor was covered with fungi of all kinds, this being the first and probably the largest crop of the season. Most abundant and conspicuous among the fleshy forms, was *Lactaria piperata,* growing in large patches and reaching the size of ordinary breakfast plates. *Lactaria volema* was also common, while *L. corrugis* was found only once. *Russula virescens, R. foetens, R. emetica,* and several purple species were seen, but the genus was not yet well represented.

Venenarius phalloides, V. rubens, V. Frostianus, and *V. solitarius* were found, but it was probably too early for *V. cothurnatus,* which was not seen in the places where it grew several years ago. The genus *Vaginata* was very well represented. *Vaginata plumbea* occurred in all color-forms; the rare *V. parcivolvata* was found twice; and *V. farinosa* once.

The Clavarias had not yet appeared; while the Hydnums were represented by *H. adustum* and *H. repandum.* Three puffballs were seen, and *Dictyophora duplicata* was unusually abundant and offensive in gardens and about bulidings. *Boletus communis, B. griseus, B. luridus, B. felleus,* and *B. bicolor* were the only members of the Boletaceae yet in evidence.

Of the fleshy forms that were eaten, the following might be mentioned: *Chanterel Chantarellus, Craterellus cornucopioides, Lycoperdon cyathiforme, L. gemmatum, Cortinarius semisanguineus, Vaginata plumbea, Lactaria volema, L. corrugis, Hydnum repandum, Boletus bicolor, Pluteus cervinus,* and *Hypomyces Lactifluorum*. Those specially avoided were species of *Venenarius* and brilliant clusters of *Clitocybe illudens*.

At Blue Ridge Springs, an unusual leaf-spot disease had almost defoliolated several box-elders and Norway maple trees, the spots being so thick on many of the leaves as to be confluent. Beneath the maples, the large diseased leaves were heaped up as though a heavy frost had occurred.

The elms at Bedford City were found to be riddled by the imported elm leaf-beetle, which, according to an observing resident physician, had been abundant there every season. No one has yet satisfactorily explained why this pest has not been seen about New York during recent years, but it may possibly have been due to adverse weather conditions.

One of the most interesting observations was made at Lynchburg, at the corner of Tenth and Harrison Streets. Here stood and English walnut tree over a hundred years old, which measured seven feet in circumference and about sixty feet in height, and had borne quantities of good nuts until about 1915. Since then, however, the nuts had been diseased and for the most part worthless. Upon closer examination, some of the green fruits hanging on the tree were seen to be partially blackened, while many entirely blackened and decayed fruits were on the ground.

The origin of this tree is unknown. It usually flowers in March and the fruit is often killed by frost. This year, however, was exceptional and the flowers appeared in February. The foliage has never been diseased. Nuts from this tree have been widely planted. A few blocks away there are two daughter trees which bear fine, healthy fruits; and the same is true of two large trees at Rustburg.

W. A. MURRILL

SEXUALITY IN THE BASIDIOMYCETES:—A REVIEW OF

BENSAUDE, MATHILDE. Recherches Sur Le Cycle Evolutif Et La Sexualité Chez Les Basidiomycètes. *Pp. 1–156, pl. 1–13, figs. 1–30.* Nemours, 1918.

The author of this extensive and what appears to be an exhaustive study of the nuclear phenomena in the mycelia of several Basidiomycetes brings again into the foreground the fundamental problem in the mushrooms, namely their sexual reproduction.

Miss Bensuade confirms in a measure the observations of Kniep (1915, '16, '17) who found that the clamp connections at the cross walls of hyphal cells serve the purpose of keeping the two nuclear elements of the "*dicaryon*" apart and thus insure the maintenance of two distinct lines of descent for the nuclei which fuse in the basidium. Kniep claimed that the origin of the binucleated condition is by the division of the nucleus of a uninucleated cell. Miss Bensaude argues for the sexual significance of the familiar hyphal anastomoses. Through the agency of anastomosing cells (plasmogamy or pseudogamy) the binucleated condition arises and this is perpetuated by conjugate division in connection with clamp formation till the nuclei fuse in the basidium.

The mycelia of three autobasidiomycetes, *Coprinus fimetarius* Fries, *Armillaria mucida* Schrad., and *Tricholoma nudum* Bull., were studied in considerable detail. The author found Bouin's picroformol the most satisfactory fixing agent and iron haematoxylin counterstained with eosine, light-green, or fuchsin, the most desirable staining method. The work proper may be divided into two parts: one dealing with the morphology and cytology of the mycelia in general and the other with the study of single spore cultures.

The studies of mycelia were made on spore cultures and mycelia gathered from the field. The author accepts R. Falck's classification of the mycelia into primary, secondary, and tertiary forms, and claims that during the first few days after germination the mycelium produced is primary in that the hyphae are more or less partitioned off into cells which have from one to

several nuclei, and also that in no case are clamps to be found at the cross walls. At this stage certain uninucleated cells give rise to varying numbers of oidia. Miss Bensuade claims that these oidia germinate. Disarticulated hyphal cells ("*pseudoidia*") are also formed which may also grow into mature mycelia. Her evidence on this point is not at all convincing. Pure cultures from isolated oidia were not made. The author further claims that these oidia may fuse with a hyphal cell and thus initiate a series of binucleated cells and ultimately the development of a carpophore.

The author grew spores of *Coprinus fimetarius* in Van Tieghem cells and succeeded in removing all but one spore so that pure cultures from single spores were obtained. Ten spores were so isolated, of which four developed mycelia. These showed all the characteristics of primary mycelia. No persistent binucleated cells were found and clamp connections did not appear at the cross walls. Of these cultures, two were transferred to media where it was possible to observe their growth for about eight months. During this period these cultures showed no carpophore development and the mycelia remained of the primary type. When portions of each of these two mycelia were planted side by side, thus forming a mixed culture, the secondary mycelial type appeared and fruit bodies were shortly afterward formed. However, the author concludes that the "*dicaryon*" does not appear in monosperm cultures of *C. fimetarius* and that the binucleated cells are formed following plasmogamy between cells coming from two different thalli. The most common method of bringing about these cell fusions is through the union of an oidium with a hyphal cell of a different mycelium. The fact that Brefeld obtained carpophores from single spore cultures of *Coprinus lagopus, C. stercorarius,* etc., only leads Miss Bensaude to conclude that some basidiomycetes are homothallic and others heterothallic, resembling in this the conditions described by Blakeslee for the Mucorineae.

The author admits that transformation of a primary into a secondary mycelium is very difficult to observe, but from her study of these single spore cultures, Miss Bensaude concludes

that after the anastomosis of two hyphal cells of different thalli, the primary mycelium takes on the characteristic of the secondary one. Through this anastomosis (plasmogamy) of cells the cytoplasm as well as the nucleus or nuclei of one cell may pass into the other. The fusion of two cells with more than two nuclei generally results in the disintegration of the superfluous ones. Unfortunately, the cytological evidence offered for this most interesting claim is altogether insufficient and the figures are quite inadequate.

The most aberrant feature in the author's results is the claim that the nuclei of the early germ tube divide amitotically. Here again the evidence does not appear to be satisfactory. Two nuclei lying close together with imperfectly stained nuclear membranes do not indicate all the conclusions that the author suggests; nor in my opinion do dark or heavily stained protoplasmic strands between two nuclei suggests anything more than imperfect staining. It seems that Flemming's Strong Solution destroys the delicate spindle fibers in the fungi. The claim that in young hyphae the nuclei rarely ever show chromatin seems to be a retrogressive step in the cytology of the fungi. A number of students of the Ascomycetes, as well as the Basidiomycetes have shown rather clearly that the nuclei of the hyphae in these fungi are quite like those of higher plants.

As noted, Miss Bensaude's account of conjugate nuclear division and the formation of clamp connections agrees with that of Kniep. The nuclear division is, as a rule, preceded by the formation of a protuberance in the middle of the cell which is to develop into a clamp. The nuclei migrate into the region of the cell where this protuberance is formed. One of the nuclei which Miss Bensaude now calls plus enters this rudimentary clamp and the other minus remains in the hyphal cell. Spindles are formed lying parallel to each other and the nuclei divide. One of the plus daughter nuclei passes back into the mother cell and the other goes to the tip of the little beak. One of the minus daughter nuclei goes to the apical portion of the mother cell, the other to the basal part. Two contiguous cross walls are formed, one at the base of the young clamp and the other in the mother

cell at the level of the clamp. The apical cell so formed has a plus and a minus daughter nucleus. The basal cell has a minus nucleus and the young clamp has a plus nucleus. Fusion now occurs between the basal cell and the young clamp and the nucleus of the clamp passes into the basal cell so that it too has a minus and a plus nucleus.

At times the clamp fuses with what will be the future basal cell before the nuclei divide, so that the apical and basal cells both contain two nuclei before cell division occurs. Intercalary cells may also divide and the nuclei here also undergo conjugate division. Conjugate nuclear and cell divisions are always associated with the formation of a clamp connection. Occasionally, however, a reversion of the characteristics of secondary mycelia to those of the primary type occurs; in which case, cells are found in the secondary hyphae which have no clamps and which produce oidia.

This admission by Miss Bensaude makes us feel that the classification of the mycelia has no real basis, for uninucleated cells and binucleated cells with clamps have been observed by others, and Kniep (1915) claimed that the binucleated condition of the cells once established, it is never interrupted. The point, undoubtedly, needs further study.

Miss Bensaude's problem is a difficult one. Her work is highly commendable, for it clearly shows the necessity of working with cultures from single spores. Her figures are undoubtedly faithful representations of her preparations, but her interpretations are not adequately supported. The results she presents are theoretical possibilities but the evidence falls short of being convincing and conclusive.

MICHAEL LEVINE

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